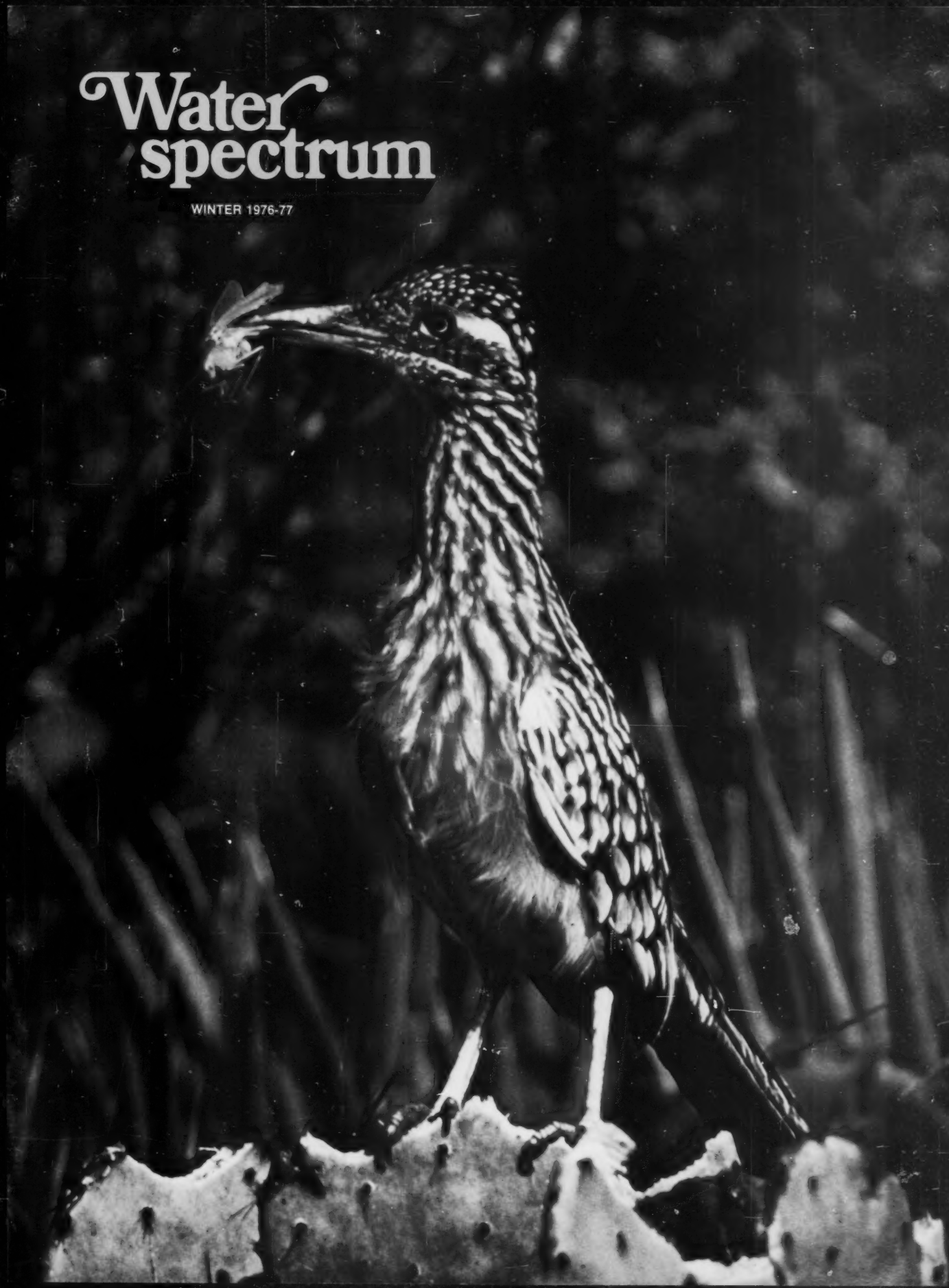
Water spectrum

WINTER 1976-77



Water spectrum

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COVER: The roadrunner, New Mexico's State bird, inhabits semiarid desert and brush country of Southwest, where State wildlife management areas supplement national conservation efforts. See page 1. Photo: Texas Parks & Wildlife Department

Where Buffalo Once Roamed

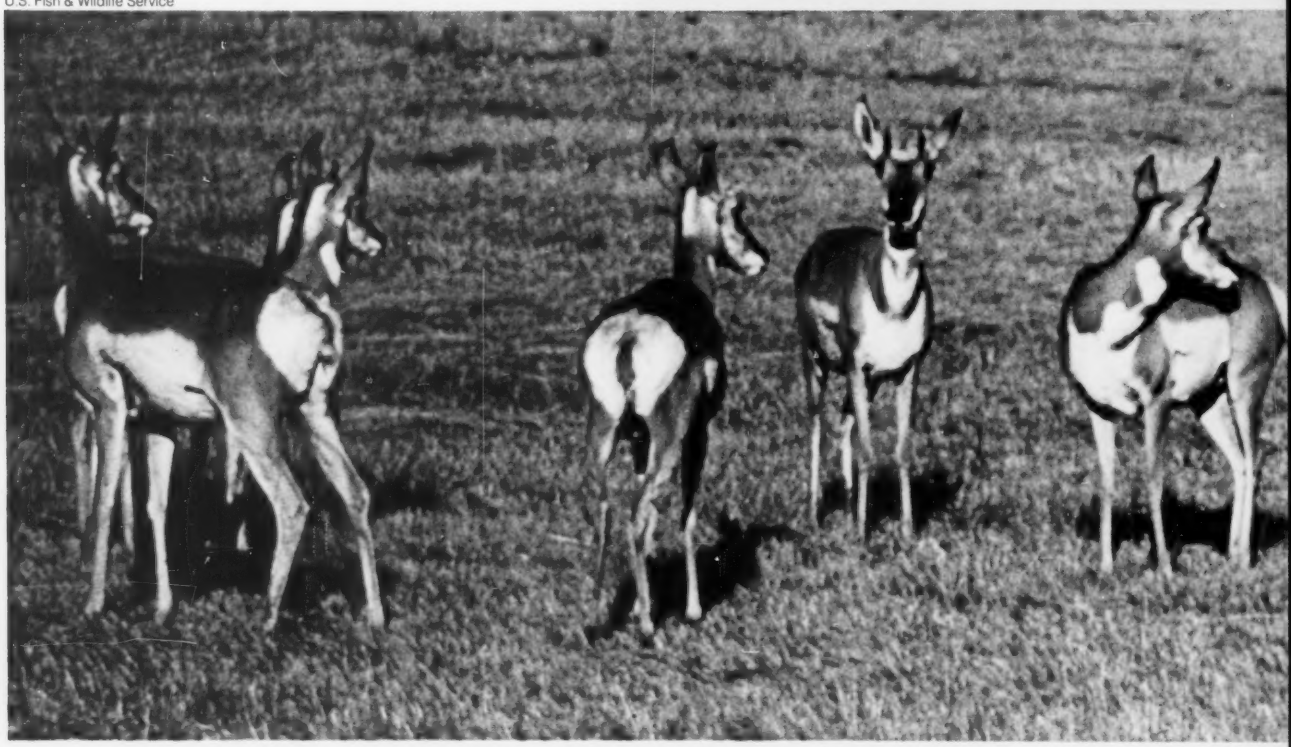
by **William T. Nallon, Jr**
Division Biologist
Southwestern Division

U.S. Fish & Wildlife Service

The bobwhite quail is the most important upland game bird throughout the Southwest.

Scattered bands of fleet-footed pronghorn antelope, often called "phantoms of the prairie," reside in Mule Creek area at Colorado's John Martin Lake on upper Arkansas River.

U.S. Fish & Wildlife Service



It was the year 1540. A small band of Spanish explorers led by Francisco Vazquez de Coronado entered Arizona and New Mexico in search of the treasure laden *"Seven Cities of Cibola."* They sought after the fabled "Cities of Gold" as far north as the Oklahoma Panhandle and the Wichita Mountains of Kansas. Although Coronado and his followers failed to find gold, they did find the Great Plains, inhabited by vast herds of bison, nomadic Indian tribes and wildlife typical of what later became this country's Southwest.

Today the once-great herds of buffalo no longer roam the prairies, although remnant herds still remain in areas such as the Wichita Mountains National Wildlife Refuge of southwestern Oklahoma. One of the largest in the Southwest, this 59,000-acre refuge was established by President Theodore Roosevelt in 1905 and also contains a herd of Texas longhorn cattle, a thriving population of elk, pronghorn antelope, wild turkeys, prairie dogs and deer.

Since the establishment of this refuge, modern day conservationists have been proving that the settling of the Southwest by the pioneers and their descendants need not destroy the region's unique wildlife to the point of extinction. The past 2 or 3 decades, in particular, have seen many changes in wildlife management, including the role played by the Southwestern Division of the U.S. Army Corps of Engineers.

This division extends to the perimeters of the major river drainage basins in this region, including such rivers as the Arkansas, White, Red, Rio Grande, Trinity, Brazos and the Sabine. Geographically, the Southwestern Division encompasses parts of the Gulf Coastal Plain, the Ozark Plateaus, the Central Lowlands Plain, the Great Plains, the southern Rocky Mountains, and the semiarid desert areas of southwest Texas and southern New Mexico.

The extreme variations in physical and climatic conditions result in a wide diversity of vegetative covers to support many wildlife inhabitants. Average rainfall can vary from as much as 56 inches annually in sections of Arkansas and Louisiana to about 8 inches in localized areas of New Mexico and Colorado. Likewise, the freeze-free periods vary from 150 days a year in Kansas and Colorado to 330 days in south Texas. The subtropical lower Rio Grande Valley, in fact, seldom records more than 2 days with freezing temperatures.

The Southwestern Division began its conservation and management efforts on behalf of the region's fish and wildlife resources about 30 years ago. In that time some 75 water-resource projects have been constructed or developed. Having become the manager of large acreages of public lands acquired as integral parts of these projects, the Corps has accepted a basic responsibility for the professional stewardship of the associated natural resources, including wildlife.

One of the first efforts within the region started shortly after World War II, when water resource development was just beginning in Oklahoma. The Tulsa District of the division borrowed a biologist from the State's game and fish agency for advice. Later employed on a permanent basis, this biologist (probably one of the first to be used in the Corps Civil Works Program) was instrumental in the district's efforts to establish the Oklahoma Fish and Game Council. Today the council is composed of representatives from the Oklahoma Department of Wildlife Conservation, the University of Oklahoma, Oklahoma State University, the U.S. Fish and Wildlife Service and the Corps. Associations formed within the council make it convenient for the State and the Corps to employ numerous graduate students to perform research work beneficial to fish and wildlife management on lakes impounded by the Corps.

These early efforts evolved into a present-day policy of making perimeter lands around lake projects available to Federal and State conservation and wildlife agencies, which have assumed management responsibility for almost a half-million acres surrounding Corps lakes under the jurisdiction of the Southwestern Division. This teamwork approach toward improving wildlife habitat has been successful in partially mitigating the original habitat lost during construction of these projects.

The Corps has cooperative programs with the several State conservation agencies in this region that include such measures as controlled grazing, plantings for both food and cover and improved cropping practices for the benefit of wildlife feeding. Forest-management practices also benefit wildlife practices by attempting to provide timber stands consisting of a diversity of tree species of all ages that can provide a wide range of food and cover. Openings of 1 to 2 acres are cut inside dense forests to increase available browse for deer and the cut treetops are piled together to create wildlife dens. Standing trees used as dens are always spared from the axe. For example, the red-cockaded woodpecker colony established at an Arkansas lake is being preserved by leaving undisturbed the pine trees infested with red-heart disease in which these birds have chosen to build their nests. Also, squirrel-nesting boxes have been placed in park areas to supplement natural nests and wood duck nesting boxes have been added at many lake sites.

Six Corps lakes in Kansas, Oklahoma, Texas and Arkansas have become the sites of wildlife refuges that form a part of the National Migratory Bird Management Program established by the U.S. Fish and Wildlife Service. These refuges are mostly within the Central Flyway, the principal route for birds migrating between nesting areas in northern United States and Canada and their wintering areas on the Texas Gulf Coast.

The six refuges provide over 96,000 acres of food, habitat and nesting sites for migrating waterfowl. Over 22 million waterfowl use-days were recorded last season, with peak day usages including 49,000 geese at Salt Plains National Wildlife Refuge in northwestern Oklahoma and 297,000 ducks at Sequoyah National Wildlife Refuge in eastern Oklahoma.

These six refuges also provide excellent habitat for resident wildlife and several migrant species on the endangered and threatened lists. For example, Great Salt Plains Lake is the wintering area for about 100 eagles, most of them bald eagles. About 35 bald eagles winter on the Flint Hills National Wildlife Refuge in Kansas and about 25 winter at Sequoyah. Small numbers also winter on Lake Texoma at the Tishomingo and Hagerman Refuges on the Oklahoma-Texas line. Salt Plains Refuge is also a stopover for a few whooping cranes and small numbers of American peregrine falcons during the fall migration to their wintering grounds on the Texas Gulf Coast at Aransas National Wildlife Refuge.

The problem of maintaining suitable refuges is compounded when large developments, such as the McClellan-Kerr Arkansas River Navigation Project, enter the picture. This project, extending from the Mississippi River to the inland port of Catoosa, Oklahoma, necessitated construction of a navigation canal through the White River National Wildlife Refuge on the lower Arkansas River. To mitigate the damage to the refuge, the Corps and the Fish and Wildlife Service collaborated on a plan to establish three "green tree" reservoirs near the canal totaling 2,540 acres. The "green tree" appellation comes from the practice of allowing these reservoirs to fill before the fall migration south and emptying them after the spring flights north.

The Arkansas Game and Fish Commission owns and manages an additional 5,200 acres of overflow land on the lower Arkansas known as the Trusten Holder Wildlife Management Area while, farther upriver, the U.S. Fish and Wildlife Service has created the Holla Bend National Wildlife Refuge at a cutoff channel constructed as part of the inland navigation project.

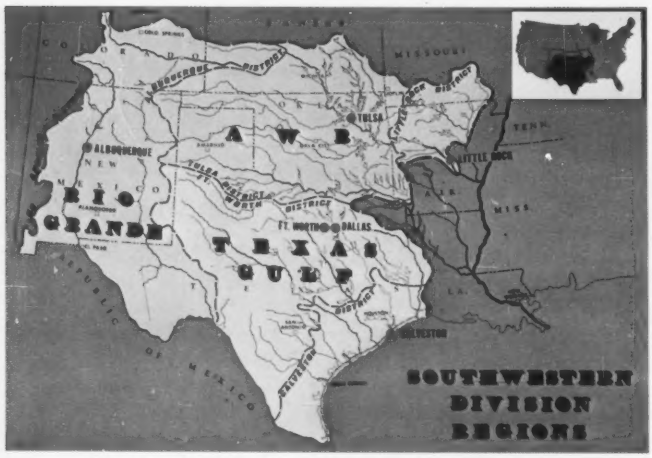
Even farther upstream, above the confluence of the Verdigris with the Arkansas, several cutoff loops in the Verdigris River section were acquired as part of that project. These oxbows provide Oklahoma with excellent fish habitat for largemouth bass, crappie, channel catfish and other indigenous species as well as species introduced to this area, such as striped bass. Fencing the lands surrounding these oxbows facilitates habitat development in some areas, which are under State management, while allocating adjoining areas for low-density recreation, industrial access and project operation and maintenance.

Another well-managed area is the White River's upper basin in southern Missouri and northwestern Arkansas, which lies principally within the geological region of the Ozark Plateaus. Here the drainage area is characterized by narrow, flat-topped ridges separated by deeply cut valleys. The heavily forested areas consist of upland hardwoods interspersed with the shortleaf pine-hardwood and the cedar-hardwood types of forest.

Wildlife management licenses have been issued to the Arkansas Game and Fish Commission for about 78,600 acres and the Missouri Conservation Commission for about 72,700 acres at seven Corps lakes within this basin. Predominantly forested, the land available for wildlife food crops is limited to scattered small openings in the forest cover. Management practices include herbaceous and woody plantings, controlled grazing and share-crop agreements with local farmers to produce grain crops, part of which remain in the field to feed wildlife.

State Management Agreements

The Corps works through each State's conservation agency wherever possible in establishing managed sites. A 21,191-acre site adjoining Bull Shoals Lake is operated by the Missouri Conservation Commission as the Drury Refuge and



Southwestern Division of Corps extends to perimeters of three major drainage basins: the Arkansas-White-Red Rivers; the Rio Grande; and the Texas Gulf, which includes the Trinity, Brazos, Colorado and Sabine Rivers.

Corps coastal dredging operations are regulated to avoid disturbing nearby whooping cranes wintering at Aransas National Wildlife Refuge.
Texas Parks and Wildlife Dept.

Immature bald eagle is one of about 35 that winter at Flint Hills National Wildlife Refuge in Kansas.
U.S. Fish & Wildlife Service

Wildlife Management Area. The primary objective is to produce wild turkey for restocking other areas in Missouri. Secondary objectives are to provide migratory waterfowl with food and maintain a resident flock of giant Canada geese.

The Arkansas Game and Fish Commission manages about 3,600 acres under license from the Corps on Nimrod Lake in the Arkansas River watershed. Part of the area has been set up as a waterfowl refuge and the remainder is used for public hunting. Similar to the green-tree reservoir concept mentioned earlier, about 1,500 acres of upland hardwood forest are flooded by means of dikes to attract mallards and other ducks during migration season.

The Oklahoma Department of Wildlife Conservation manages over 175,000 acres on 14 Corps projects through license agreements. In the planning stage are similar agreements for several other projects, which will raise the State total to 200,000 or more acres. These lands are managed primarily for public hunting of waterfowl or upland game, depending on what each area will support. Upland game management involves bobwhite quail, mourning doves and cottontail rabbits in most areas. The ring-necked pheasant and the greater and lesser prairie chicken have a more limited range. Several areas support whitetail deer and Rio Grande turkey.

Typical of the management units operated by Oklahoma is the 16,776-acre Canton Lake Game Management Area in the western part of the State. This area consists mostly of

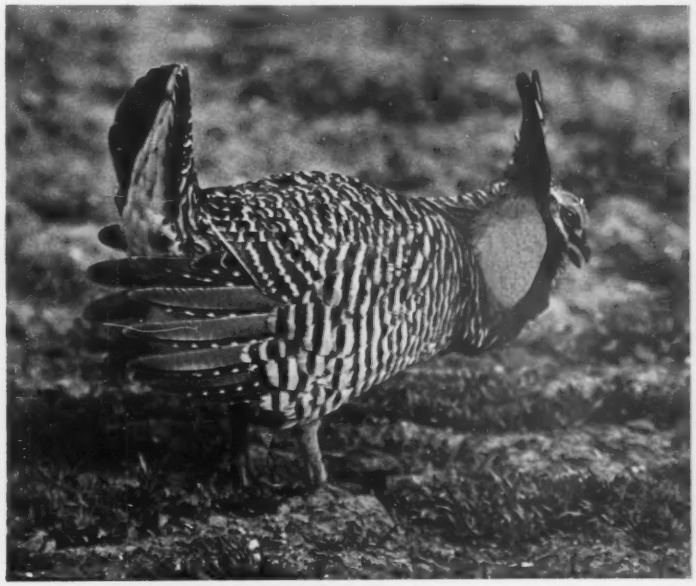
Although chachalaca, or Mexican pheasant, has limited range of counties in Rio Grande delta, its population size permits Texas to issue hunting licenses for 2-month season.
Texas Parks & Wildlife Dept.

stabilized sand dunes covered with native grasses, woody shrubs and timber. Share-crop agreements with local farmers, who are asked to leave a portion of the crops in the field, and plots of small grains, sorghums, legumes or native weeds provide food for wildlife. Strip clearings through the blackjack and post oak provide openings for additional food plantings and serve as wildife travel lanes. Manipulation of the vegetative cover through a controlled cattle grazing program and a limited amount of prescribed burning also contribute to optimum wildlife use of the lake's perimeter lands, identified by boundary fences and information signs.

The Oklahoma Department of Wildlife Conservation estimates this management area will eventually support over 8,000 man-days of hunting annually. Although the fall hunting population of bobwhite quail reached a peak of 14,000 in 1958, the normal population is closer to 6,000 birds. The peak dove population has been estimated at 5,000, the normal population of whitetail deer at about 400 and that of Rio Grande turkey at 125. Similar waterfowl management programs exist at the Wister Lake and Hulah Lake Game Management Areas in southeastern and northern Oklahoma, respectively.

Many States permit public access to unrestricted parts of waterfowl refuges such as this duck hunting area at a Corps built lake project in Little Rock District.

Greater prairie chicken, noted for its "booming" during courtship, inhabits limited ranges of the tall-grass prairies.
U.S. Fish & Wildlife Service



The Kansas Forestry, Fish and Game Commission manages 35,130 acres on six Corps lakes in the northern part of that State. An outstanding example is the Fall River Lake Game Management Area that the State agency assumed responsibility for in 1961. The 10,892 acres of agricultural and pasture land have been converted into a high quality public hunting area for bobwhite quail, rabbit, greater prairie chicken, mourning dove, fox, squirrel, deer and several species of waterfowl. Situated mostly in a wide, fertile flood plain valley surrounded by adjacent upland prairies of tall grass and oak forest, this area provides the prairie chicken with lowland feeding sites close to its native upland nesting and roosting requirements. Plenty of aquatic habitat and food attracts numerous ducks and geese during the migration seasons. As a result of this, wintering populations have been steadily increasing.

The Colorado Division of Wildlife manages 16,802 acres at John Martin Lake near the 100th meridian, which is considered the general dividing line between eastern and western species. Extending almost due west across this meridian, the broad, irrigated valley of the Arkansas River acts as a natural channel for many eastern species to range westward and mix with western species within this project. Thus, both mule and whitetail deer may be found among the timber and brush of the flood plain along with many species of small mammals.

Thick stands of salt cedar along the river and the marshes next to the lake provide habitat for both raptors and waterfowl. Game birds are prevalent in the adjacent flood plain, while the grass meadows surrounding the project contain many species of song birds and rodents. Scattered bands of pronghorn antelope reside in the Mule Creek area. Among endangered species are the American peregrine falcon, a casual migrant, and the black-footed ferret, associated with the region's prairie dog towns. The most recent ferret sighting in this general area occurred in 1972.

The Texas Parks and Wildlife Department manages 22,370 acres on two Corps projects in that State. First of its type to be authorized by the Texas Legislature, a 4,000-acre site on the upper end of B. A. Steinhagen Lake in east Texas has been designated Angelina-Neches Scientific Area No. 1, since it lies between those two rivers. An ideal duck feeding

ground, the scientific area is a prime example of a southern hardwood river bottom forest and an extension of the Big Thicket terrain that lies less than 30 miles west. Dan Lay, dean of the State's wildlife biologists, is assigned to supervise the area and a five-man steering committee is directing research toward interpreting the area's unique wildlife values.

Among the endangered species reported was an ivory-billed woodpecker; however, a flurry of activity among bird watchers failed to verify the sighting. There is, on the other hand, a resident population of the also endangered red-cockaded woodpecker. Back along Bee Tree Slough the American alligator leaves its tracks but is not numerous. Undoubtedly resident at one time, the Texas red wolf wanders through only occasionally, although a population nucleus of this rare wolf still exists downstream from the scientific area in the Gulf Coast marsh below Beaumont.

Another Texas research area is located at the O. C. Fisher Dam and Lake near San Angelo, where approximately 4,600 acres are leased to Angelo State University to develop a joint experiment station with Texas A&M University for research into the management of livestock and wildlife. This area is as habitually dry as the preceding project area is characteristically wet. One of the objectives is to increase wildlife populations by determining how to make them compatible with this area's cattle and sheep ranching. Much of the cattle and sheep range is overgrown with mesquite, prickly pear, juniper and other vegetative cover typical of the Edwards Plateau and rolling plains of southwest Texas. Some 3,400 acres of pasture on the station were revamped by bulldozing and root plowing, and then replanted in grasses and forbs. Brush was gathered into piles and positioned for escape cover. Strips of mesquite and juniper were left intact for quail cover, while some areas were strip cleared for the benefit of deer and turkey.

The Texas Gulf coastal region exhibits still another set of habitat characteristics that both Federal and State agencies have capitalized on for preservation purposes. This region begins with the barrier islands that parallel the coast and extends inland as far as 200 miles. The low topographic relief of the more than 200 million acres in this region is covered by a variety of habitats ranging from the dense hardwood forests in the southeast to open brushland. The coastal wetlands are important feeding and resting grounds for the numerous varieties of ducks and geese that winter here. There are at least 12 species of herons and egrets, including bitterns, that are commonly present. Although plume hunters threatened several species with extinction at the turn of the century, especially the elegantly plumed snowy egret, these birds are now protected by law and most have maintained stable populations.

Among the other long-legged waders that attract bird lovers are the wood stork, white-faced ibis, white ibis, roseate spoonbill, whooping crane and sandhill crane. The other types of large aquatic birds of particular interest in this area include the anhinga, cormorant, and the white and brown pelicans. The brown pelican has become extremely rare and is presently restricted to localized populations along the middle and lower Texas coast. This points up the usefulness of slowly building islands out of material dredged from navigation channels and then developing them into rookeries. Among the more substantial rookeries created from this source are Brown Pelican Island, which is adjacent to the Corpus Christi Ship Channel. This island is one of the few localities where its namesake has been known to nest in recent years. Sydney Island, which is along the Sabine-Neches Channel in Sabine Lake, supports the largest known colony of roseate spoonbills in the State. Another important disposal island emerging adjacent to the Galveston Bay part of the Gulf Intracoastal Waterway is North Deer Island.

Share-crop agreements with farmers provide wildlife food plots.

These islands have been established as bird sanctuaries under a cooperative agreement among the National Audubon Society, Federal and State wildlife and pollution control agencies and the Corps, which schedules its maintenance dredging activities both to avoid disturbing nesting localities and to enlarge bird habitat through well planned disposal of dredged material.

The Corps is engaged in other cooperative programs that also protect rare and endangered species. These include regulation of dredging operations to avoid disturbing wintering whooping cranes and nesting mottled ducks near the Aransas National Wildlife Refuge and one of the few remaining bald eagle nests along the tributary channel to the city of Victoria.

Although Coronado never found the legendary "Cities of Gold," his expedition did lead the way to eventual settlement of the Southwest and was an important factor in molding our present day cultural attitudes. We are attempting, through conservation and management efforts, to preserve from extinction and maintain in the "wild" most of the indigenous species that existed in Coronado's time.

As our human population continues to increase, the accompanying urbanization—including development of man-made lakes to supply expanding water needs—will continue to require some sacrifices of wildlife habitat. Merely dedicating public lands to wildlife management programs such as those described does not solve all the problems related to maintaining desirable populations and meeting public hunting needs. In the future, therefore, the role of public lands will become more critical in our planning efforts. The necessity of accommodating more and more humans will require exploration of every possible alternative in order to lessen the adverse impacts on wildlife. ■

Royal terns and black skimmer nestlings utilize Gulf coastal islands formed from dredged material.
C. O. Martin

Port Development Catches Up in the UK

by **Douglas J. Bright**

Paceco

Night view of container-handling equipment at Port of Felixstowe in southeast England symbolizes United Kingdom's port modernization efforts.

Following is the third in a series of articles written by representatives of PIANC nations.[1] *The author explains his own country's reaction to the modern day problem of port obsolescence, a vital consideration for a predominantly maritime nation such as the United Kingdom.*

Appearance of the "supership" on the high seas triggered an amazingly rapid increase in shipping efficiency that could not help but emphasize the inability of long-established world ports to service this new breed of seagoing vessel. It was as if a maritime explosion had rocked the very foundations of traditional cargo-handling concepts at every port engaged in international commerce. In the United Kingdom, this relatively overnight transformation in ship sizes became the impetus for a decade of long-desired improvements that is modernizing our major ports.

Port development and modernization took on the mantle of a formally announced national policy upon the official promulgation of the Harbours Act of 1964. The changes supported by this legislation were based in large part on recommendations presented to Parliament in September of 1962 by the then Minister of Transport. These recommendations were, in turn, influenced by a report issued from a committee set up by the Minister a year earlier to consider the physical adequacy of Great Britain's major docks and harbors and possible improvements in cargo handling.

The committee, chaired by Viscount Rochdale, issued a report containing a number of recommendations that, in addition to supplying the basis for the 1964 legislation, covered subjects such as the organization and management, labor, plant and equipment, finance, planning, access and research relating to the major docks and harbors throughout the United Kingdom.

The Rochdale Report

At the time of the Rochdale Report the ports in the United Kingdom were rapidly becoming obsolete. They had been built largely during the last century and the early part of the present one, when the means of transport on the landward side consisted of railway or horse drawn vehicles. Two- and three-story transit sheds, erected close behind the narrow aprons on each quay, made it possible to store cargos so that a minimum of movement would be necessary between ship and shed, but they limited quayside maneuvering room.

Quay built in early 1900s has typically narrow apron separating vessels from dockside warehouses.

Loading and unloading was very slow and labor-intensive. General cargos were handled piecemeal by large groups of longshoremen using wheel-barrows and small port cranes. Timber, for example, was unloaded piece by piece, a practice which wasted time, manpower and the timber itself, since a surprising amount fell into the water, was left lying about on the docks or was easily pilfered.

The ports themselves often were cramped into small areas located in the middle of cities and towns with little room for expansion. Furthermore, they were usually located far up a tidal river in shallow water, where present-day ships would run aground before reaching them. The reason they were built so far upstream was largely a matter of the transport available and the need to be near the industrial and commer-

[1] Preceding articles relating to the aims of member-nations of the Permanent International Association of Navigation Congresses appeared in the Winter 1975 and Summer-Fall 1976 issues.

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The author was Harbour Engineer for the Ports Directorate of the Department of the Environment located in London.

Sheet-steel piling forms new quay facing during construction of container terminal at Southampton.

Port of Southampton caters to container ships through mechanization of container handling.

cial centers. Some prime examples were the St. Katherine, London and Surrey Docks in the Port of London and the South Docks at Liverpool, all of which have now been closed. The Port of London Authority had been particularly far-sighted in that, many years ago, it had established additional docks on the Thames farther downriver at Tilbury. Between 1927 and 1929 the authority constructed a new lock entrance built to Panama Canal measurements.[1] Expansion began in 1963 with the building of a new dock catering to mechanized handling of containerized cargo and packaged timber.

Those factors noted in the Rochdale Report that played the most important roles in proving the need for port improvements were the changes in ship sizes, advances in port mechanization and containerization, increasing use of highway transportation and the need for greater efficiency in quayside operations.

[1]The measurements were 1,000 feet (304.9 meters) long, 110 feet (33.5 meters) wide and 45.5 feet (13.87 meters) deep.

Supership Effect

Although rapid changes in ship sizes had a considerable impact on the layout and design of the port improvements, a touch of hindsight will show how little prepared the ports world was for this explosion.

Some of the papers read during the PIANC Congress of 1961 in Baltimore[2] mentioned that the major oil companies were committed at the time to the construction of what then were considered "huge tankers" in the 65,000 to 100,000 dead weight tons (dwt) range. This information produced a discussion on designing new terminals that could accommodate such large vessels. *Lloyds List,* in a 1962 article on ore carriers, reported that "Although most of the existing ore carriers are in the 14,000 to 18,000 dwt range suitable for our present ports, there are also a great number of larger ships up to 60,000 tons dead weight." The article went on to say, "It seems reasonable to take 35,000 tons as a desirable ship size, bearing in mind that every increase in size means more alterations to existing ports."

The following year another article on Britain's ore import trade referred to the lack of natural deep water harbors near steel works and advised its readers that, for the foreseeable future, very few ore carriers larger than 45,000 tons capacity seemed likely to be used for importing ore. At that time general cargo vessels had reached a capacity approaching some 12,500 dwt.

Such predictions soon proved extremely shortsighted as a result of three unanticipated alterations in world shipping practices during the mid-60s. These were the newly discovered economics of large-scale cargo movements, the long-term closure of the Suez Canal by the Israeli War of 1967—which greatly extended many voyages—and the advent of the containerization principle in cargo handling.

It was only 8 years later, at their 1969 Congress in Paris, that PIANC delegates were discussing problems arising from the use of very large ships on the order of 200,000 to 250,000

[2]PIANC convenes quadrennially at a city located within one of its member-nations.

dwt. They were forecasting (this time correctly) the need for port structures that could cater to ships of 500,000 dwt or more, sizes that exist today in the case of some oil tankers.

In contrast, dry-cargo vessels, which carry the general type cargos, have changed very little in average size since 1962. The exception is the container ship, which was introduced to Europe in the 1966-67 period. With a capacity of up to 50,000 dwt, this type of vessel can carry up to 2,500 containers.

The effects of these changes on United Kingdom ports have been to introduce requirements for deeper water and, following American practice, more space to accommodate containers and unit loads, such as packaged timber. Both of these objectives can be achieved by moving existing ports downriver and onto the estuaries in order to be closer to the sea and, where possible, away from built-up areas. The results have been rather interesting engineering schemes for the new facilities being constructed.

Port Development

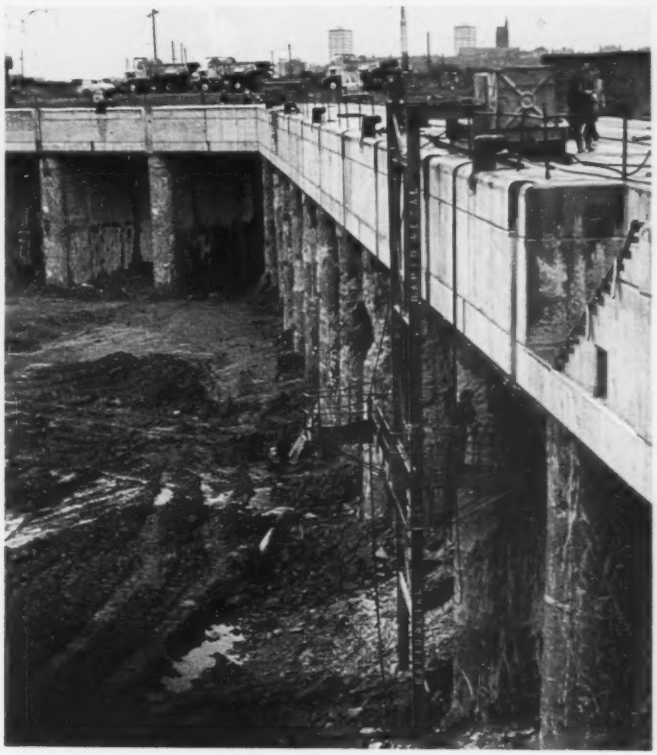
The Harbours Act of 1964 gave the Minister of Transport powers to control all port developments costing over £0.5 million, which has since been increased to £1 million.[3] That act also allows the Minister (subject to Treasury approval) to make grants and loans to port authorities. One of the act's most important functions, however, was to set up a National Ports Council to formulate comprehensive plans for improving existing ports and providing for new harbors in Great Britain. The council also became responsible for tendering advice to the Minister of Transport on various aspects of port development. These include applications for development authorization, applications for grants and loans, and providing research support.

One of the council's first jobs was to formulate an interim national plan for the major ports, most of which has now been completed. The individual port authorities, with the assistance of loans and grants from the government, carried out the plan with occasional modifications based on local requirements. Some of the major schemes proposed in the plan are described below.

At Liverpool a complete new dock, called the Royal Seaforth, has been built at the seaward end of the existing docks. Unlike the cramped space at the latter, the Royal Seaforth provides large areas of backup land for mechanized vehicle access and larger berthing areas off its quays to accommodate larger vessels. Water depth at the £41 million Royal Seaforth Dock is approximately 50 feet (15.2 meters), which will

[3]In 1964 the British pound was equivalent to $2.80. Today, however, the floating rate of exchange approximates $1.70.

View from roll-on/roll-off bridge looking into ship berthed at Hull's container terminal. Another view shows trailer-mounted container being backed into ship at Southampton's terminal.



View of concrete diaphragm walling, now below water level, before river was allowed to flood newly excavated area adjacent to Royal Seaforth Docks.

accommodate modern container and grain ships as well as those specializing in carrying packaged meat and timber cargos.

The side of the new dock facing out toward the Mersey River and Liverpool Bay has a seawall consisting of substantial natural stone armoring. The land side, facing the inside berths, is constructed of diaphragm walling where the level of the ground allowed. This type of construction acts similarly to a basement wall in that it supports the structure resting on it and serves as a barrier to ground-water seepage.

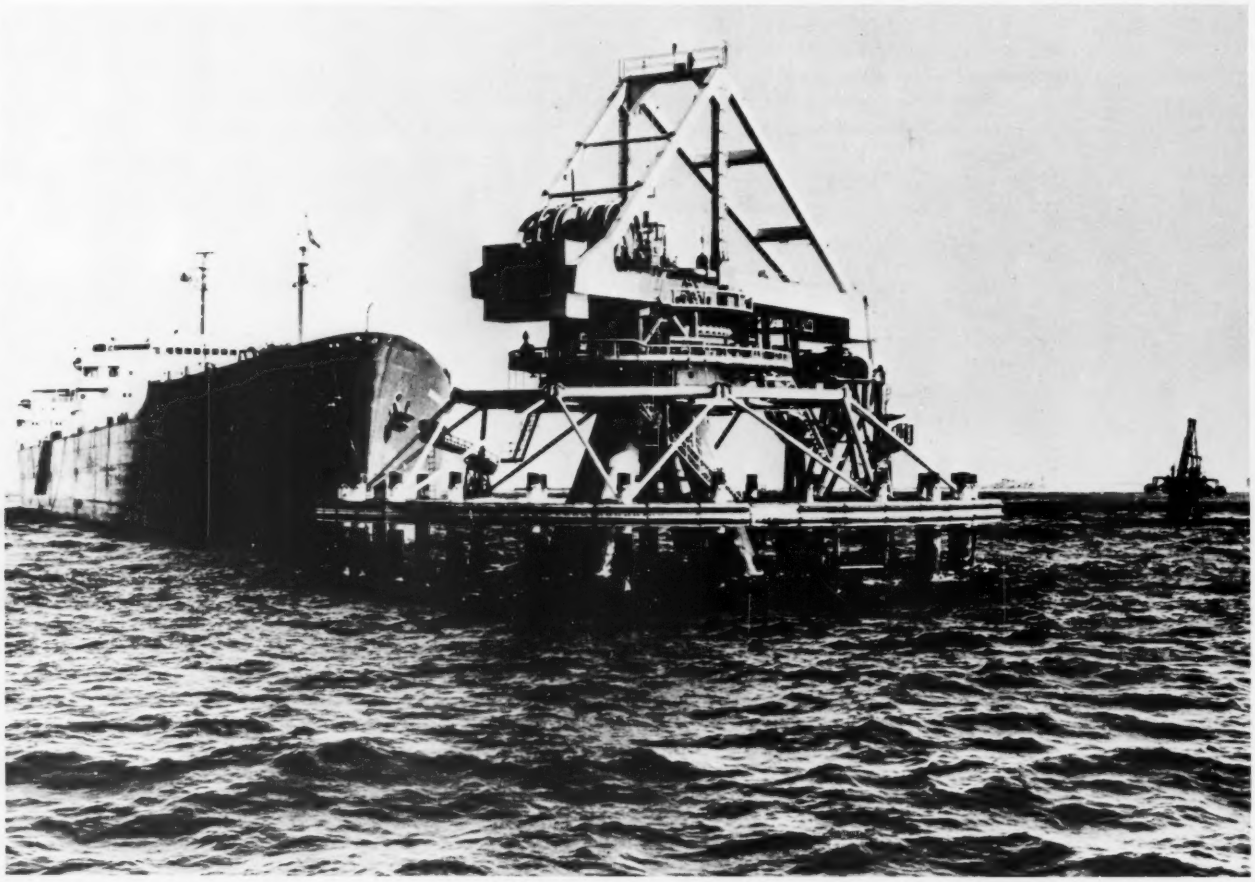
The wall is formed by excavating a trench into which a mixture of expandable clay and water—bentonite slurry—is pumped to keep the earthen walls from collapsing inward. Then, either concrete monoliths are lowered into the trench, or, as was done at Seaforth, concrete is pumped into the trench from the bottom, displacing the slurry as it rises toward the top.

After the concrete has solidified, the earth is dug away, leaving an exposed quay wall. Pressure from the earth behind the wall would soon push it over if the wall were left to stand with no support. The wall is strengthened and stabilized against the earth by laying a heavy horizontal layer of reinforced concrete across the top. This layer of concrete also serves as a quay apron.

At Seaforth, ingenious "wine glass" shaped arches were used to dilute this effect. Not only was each arch individually anchored into the earth behind, but each set of contiguous arches was joined by transverse walls to counteract the outward push of the earth.

A second major construction effort on the Mersey was the building of a tanker terminal to supply the Shell Stanlow Refinery at Tranmere. Berths at this terminal can accommodate fully loaded tankers up to 95,000 dwt or partially loaded tankers as large as 244,000 dwt.

Another modern development near Tranmere is the use of offshore moorings in response to increased ship sizes. Instead of pulling into port, oversized tankers can tie up to a single offshore point in deep water and pump their cargo of oil into a pipe that runs from the offshore buoy to an onshore storage tank. A single buoy mooring has been established off the island of Anglesey, North Wales, in some 120 feet (36.6 meters) of water to service tankers too large to reach Tranmere. The island's little fishing village of Amlwch, which faces the Irish Sea, has been reconstructed to service and operate the new terminal, and the pipeline connecting the buoy to the refinery will be run across the northern part of Snowdonia National Park in northwest Wales.



Exxon Corporation

Single-point mooring facility is a buoy anchored offshore that permits deep-draft supertankers to load or unload in open water even under adverse weather conditions. Mooring parts rotate about a fixed point, which lets vessels move with wind, wave and current shifts while remaining connected to shore-based submarine pipeline.

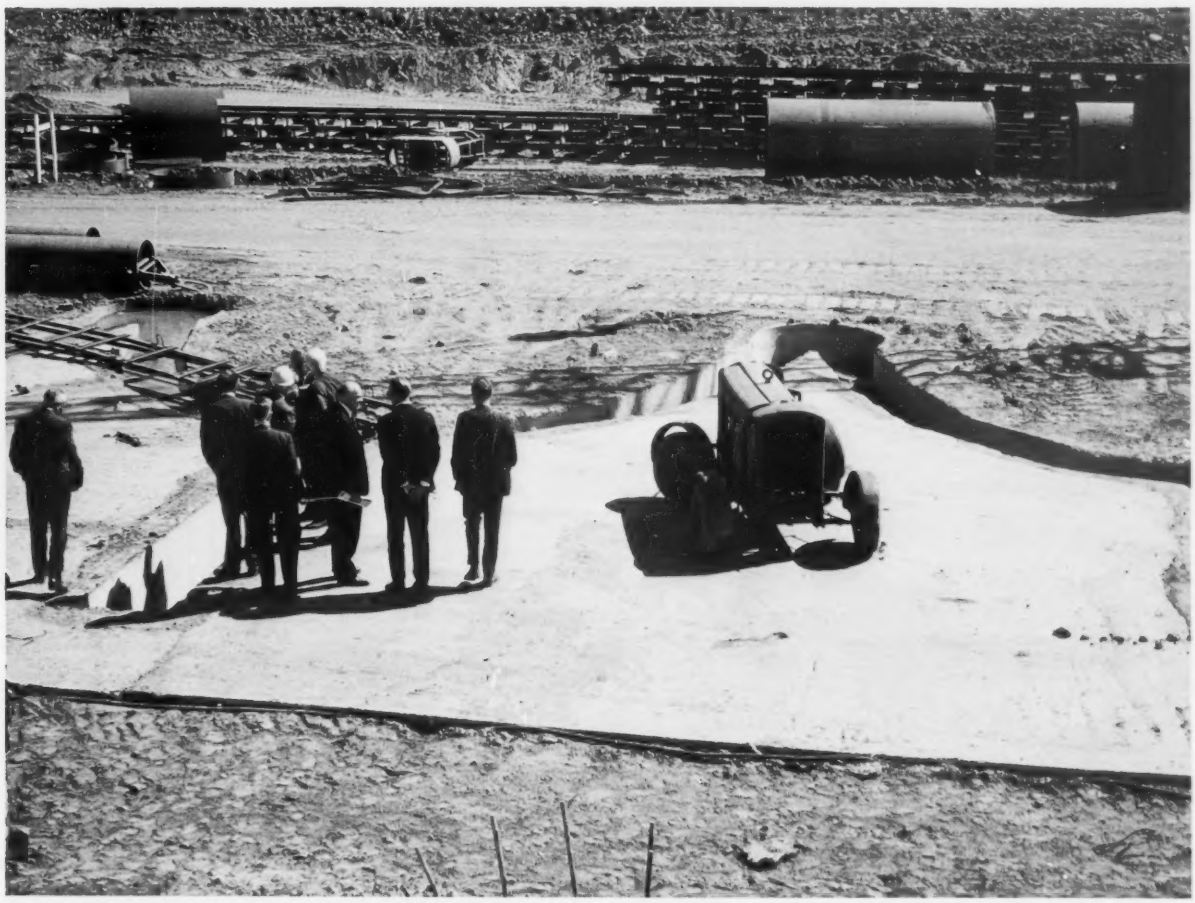
Milford Haven, in the far western part of South Wales, is now the largest oil port in the United Kingdom. Major oil companies have constructed deep water jetties in its natural harbor and built new refineries in the hinterlands, one of them choosing to pump imported crude some 60 miles (96 kilometers) to an inland refinery.

The Milford Haven Conservancy Board, which controls the port, has deepened the channel to allow the entrance of tankers up to 270,000 dwt. This involved a good deal of rock dredging, for which a floating barge was used inside the harbor to drill the underwater shot holes for blasting.

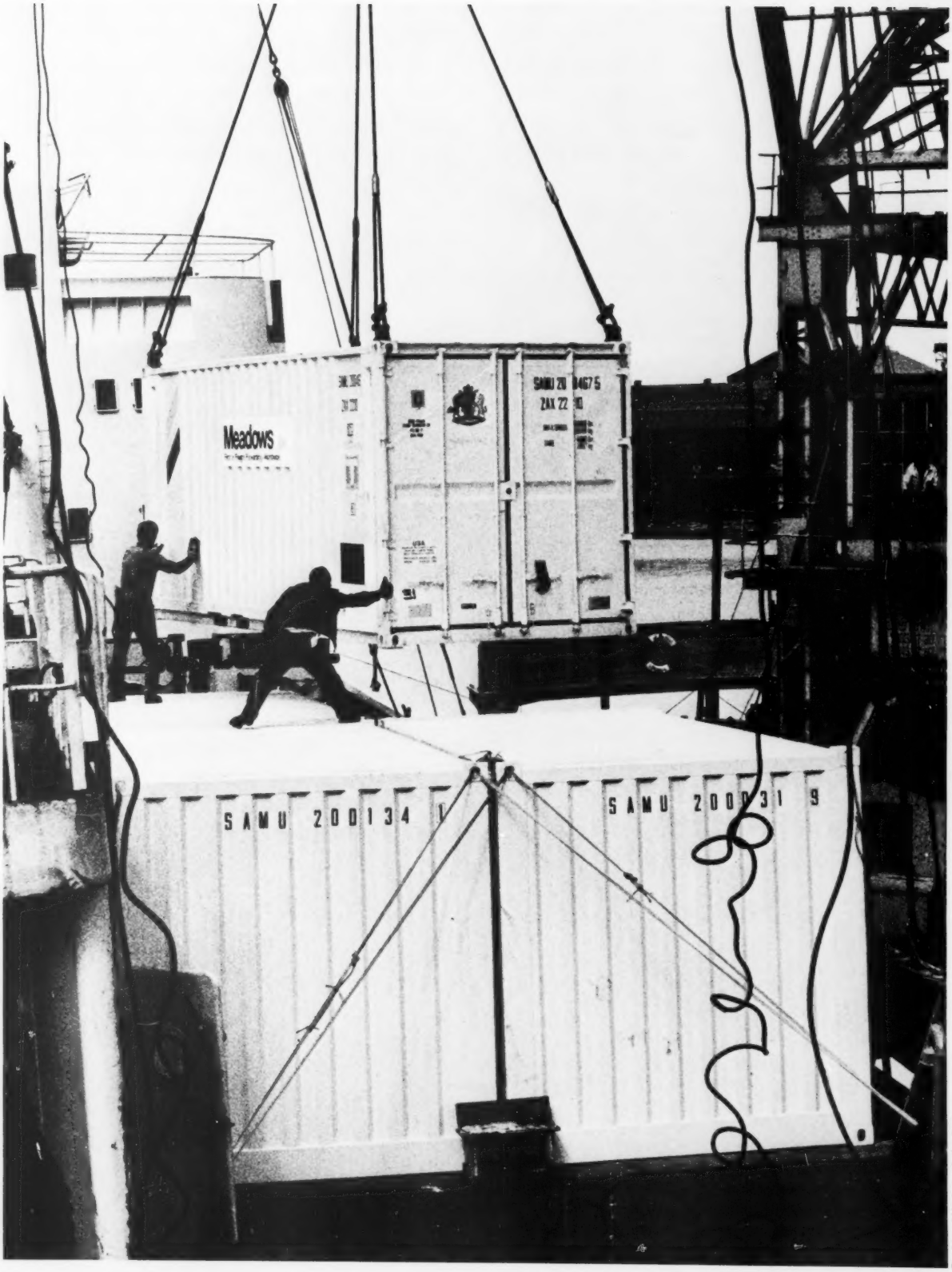
At southern England's Southampton, the shallowness of the Test River has made it possible to undertake yet another type of improvement. A large land area has been reclaimed by dredging a deep channel and pumping the green sand, which is excellent land fill, onto the adjacent flats. A new 4,900-foot (1,493.5-meter) long quay, constructed of sheet steel piling, provides a number of berths capable of servicing container ships. Southampton is fortunate in having the natural advantage of very long periods of high tide and very short periods of low tide. A lock is not even considered necessary due to the configuration of the approach channel around the Isle of Wight and the fairly small range between low and high tides from the English Channel.

Like Southampton, the Port of Hull on the Humber is also administered by the British Transport Docks Board, which has extended Hull's largest dock, the King George, by adding the new Queen Elizabeth Dock. Both docks now possess one container and five roll-on/roll-off terminals, which allow tractor trailers to be driven right onto each ship in order to service the maritime trade with the Scandinavian, German and Dutch ports across the North Sea. Unlike conditions at Southampton, an existing lock was retained to maintain constant water depths against the Humber's extreme tidal range.

Farther down the Humber and across the river, two jetty terminals have been constructed in the deeper water at Immingham. Use of one of these jetties, located on the west side of Immingham Dock, is shared by the National Coal Board and the British Steel Corporation. Coal is exported from one section of the jetty head and iron ore imported at the other section. The second deep water jetty, to the east of the dock, is an oil terminal servicing vessels up to 65,000 dwt. A navigation channel had to be dredged below this jetty to allow tankers to negotiate the Grimsby Shoal downstream. Constant dredging is required at the shoal to maintain this channel.



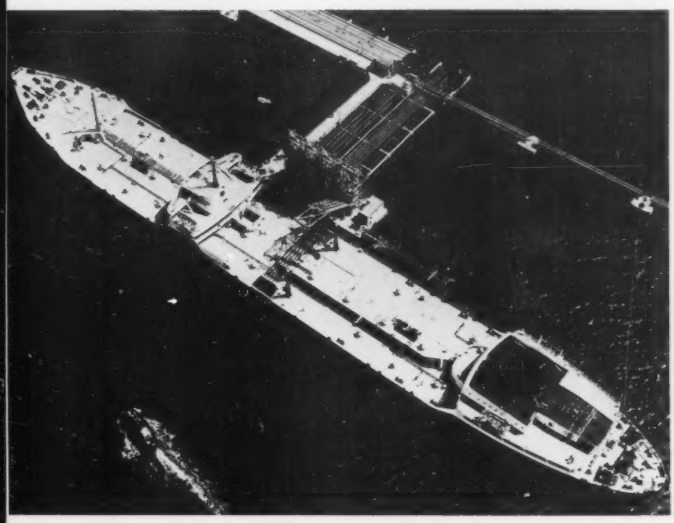
Unusual "wine glass" shaped concrete template shown being inspected at beginning of excavation preceding pouring of diaphragm walling to support Liverpool's Royal Seaforth Docks. Today all of area to rear of "wine glasses" has been excavated and filled by river water.



Dock and Harbour Authority

In typical container shipment, knitting patterns from Scotland are being loaded for South Africa at the port of Liverpool.

Major oil companies have built new refineries that can unload supertankers through oil pipelines connected directly to deep water port facilities.



Texaco Inc.

An interesting phenomenon occurred during construction of one of the two deep water jetties added to the port of Immingham on the Humber. This jetty was built as an oil terminal to service vessels up to 65,000 dwt. The strong tidal currents common to the area have been found to induce strong eddies that cause vibration of the extremely long piles necessary to support this jetty. Experimental piles have been driven into the river bottom adjacent to the jetty to study this phenomenon.

The trend toward moving ports closer to the sea has been most marked at the mouth of the Tees, which also empties into the North Sea off northern England. A substantial area of tidal sandbanks within the shelter of two breakwaters at the mouth of the river has been reclaimed with material dredged from the entrance channel. Refinery and petrochemical firms have been established on the north side, at Seal Sands, which can be supplied by large tankers able to berth at the deep water jetties. There is also a Norwegian-owned oil pipeline coming ashore from the Ekofisk field that is connected to coastal processing and storage facilities.

At Redcar, on the south side of the river, is another refinery and a new steel works, both served by deep water terminals. The successful use of diaphragm walling for the quays at the Royal Seaforth Dock encouraged adaptation of a similar method at Redcar. The quay at Redcar consists of arched front and rear walls about 80 feet (24.4 meters) apart. Transverse walls tie the front- and rear-wall arches together.

The navigation channel has been deepened to 47 feet, 6 inches (14.5 meters) and the berthing area dredged to 57 feet, 9 inches (17.6 meters) to handle ships ranging up to 150,000 dwt, depending on the level of the tides. Further dredging would give the quay at Redcar a potential for vessels up to 350,000 dwt. The major works, those requiring government approval, in this region of the Tees have cost about £17 million.

Scotland

More recent developments have been taking place in the Scottish ports, where the growing North Sea oil industry is encouraging growth of two types: some ports are being developed to service rigs and pipe-laying barges; others are being built to export the oil arriving ashore by pipeline.

Ports being developed for servicing include Lerwick on the Shetland Islands, the harbor of refuge at Peterhead, Aberdeen (which has become the Houston of Scotland), Montrose and Dundee. The essential requirement for ports of service is to have storage facilities for cement, pipes, mud and other stores close to the berths, so that servicing vessels may call or leave without delay on any tide.

The local councils for the Shetlands and the Orkney Islands have formed themselves into new port authorities to control the development of oil exports. Equal consideration has been given to the impact on the local population's lifestyle and the environmental effects in planning this development. Pipelines from the North Sea oilfields are being laid into the shore at both these archipelagos. The terminal for the Shetlands will be built in a deep water inlet known as Sullom Voe, where a number of jetties and storage tanks are under construction.

In the Orkneys, the first of several single-point moorings to load oil tankers is under construction at the famous naval base of Scapa Flow. Each mooring will consist of a large diameter steel tube, containing flexible oil lines, sunk into the sea bed with a revolving platform providing moorings.

A new lock has been built at Leith on the Firth of Forth along with the impounding of its large tidal harbor. Another new lock was constructed farther up river at Grangemouth, where Scotland's own oil refinery is situated, and an island jetty has been built in the estuary by the Forth Port Authority for exporting the surplus crude oil received from the North Sea Forties field.

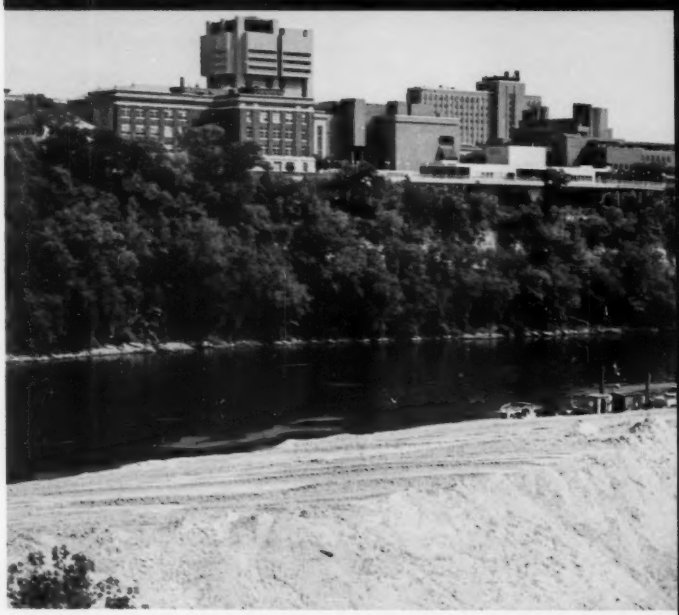
On the Clyde, which flows past the city of Glasgow, a large container depot and a terminal capable of taking the largest tankers afloat have been completed, while an iron-ore terminal jetty is under construction in the deeper water of the lower estuary.

The total cost of these major works carried out in the last dozen years amounts to something like £400 million. A considerable number of other schemes, which cost below the £1 million minimum requiring governmental approval, have been carried out by the individual ports under their own authorities. Most of these have been in connection with improvements intended for container and roll-on/roll-off traffic. In some cases, port authorities have concentrated on a general clean up, replacing old buildings and opening up the overall dock space to accommodate more mechanized equipment. There is also a continuing program of reconstructing major fishing ports.

From a maritime viewpoint, the last decade has been one of enormous engineering and economic activity in modernizing ports throughout the United Kingdom to meet the demands of the supership era and to enter the age of mechanization and containerization in cargo handling. ■

A TEAM CALLED GREAT

by **George W. Griebenow**
Chairman, Upper Mississippi
River Basin Commission



Established in 1972 by the President at the request of the Governors from those States within the drainage basin of the upper Mississippi River, the Upper Mississippi River Basin Commission is responsible for developing and implementing a regionwide planning process that accounts for all policy, availability, demand and problem resolution aspects of the basin's water and land resources. That process is intended to produce a regionwide plan for the development, management and conservation of these resources that is acceptable to all those party to the process. The commission is chaired by George W. Griebenow, appointed by, and serving at the pleasure of, the President. The commission members are the 10 major Federal agencies that have water and land resource programs, each

represented by the chief executive from the agency's regional office, and the Governors of Illinois, Iowa, Minnesota, Missouri, North Dakota, Wisconsin, with South Dakota as an observer, each of whom has a personal representative as his delegate.

The Chippewa (Ojibwa) word "mississippi" translates literally into "great river."

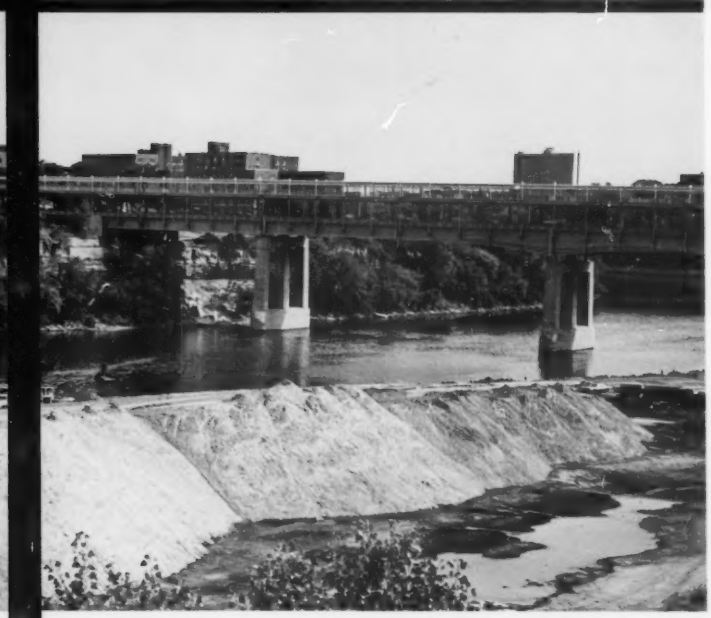
Though there had been past instances of interstate and interagency cooperation in the planning and managing of the Mississippi as a vast water resource, there was little genuine planning coordination until the establishment of the Upper Mississippi River Basin Commission and its regionwide water resource planning program.

As a result of the commission's dedication to the philosophy of maximum participation by the public, the upper part of the Mississippi River has become the beneficiary of a productive, basinwide atmosphere of public decision making. One of the most visible programs is under the leadership of the commission's Great River Environmental Action Team—a team called GREAT.

This working partnership between public interests and all levels of government is a story of Yankee ingenuity at its best, an account of open heart surgery on the "Father of Waters" to repair, rejuvenate, heal and restore while, at the same time, improving its economic capacity to serve some 18 million people residing within the upper basin.

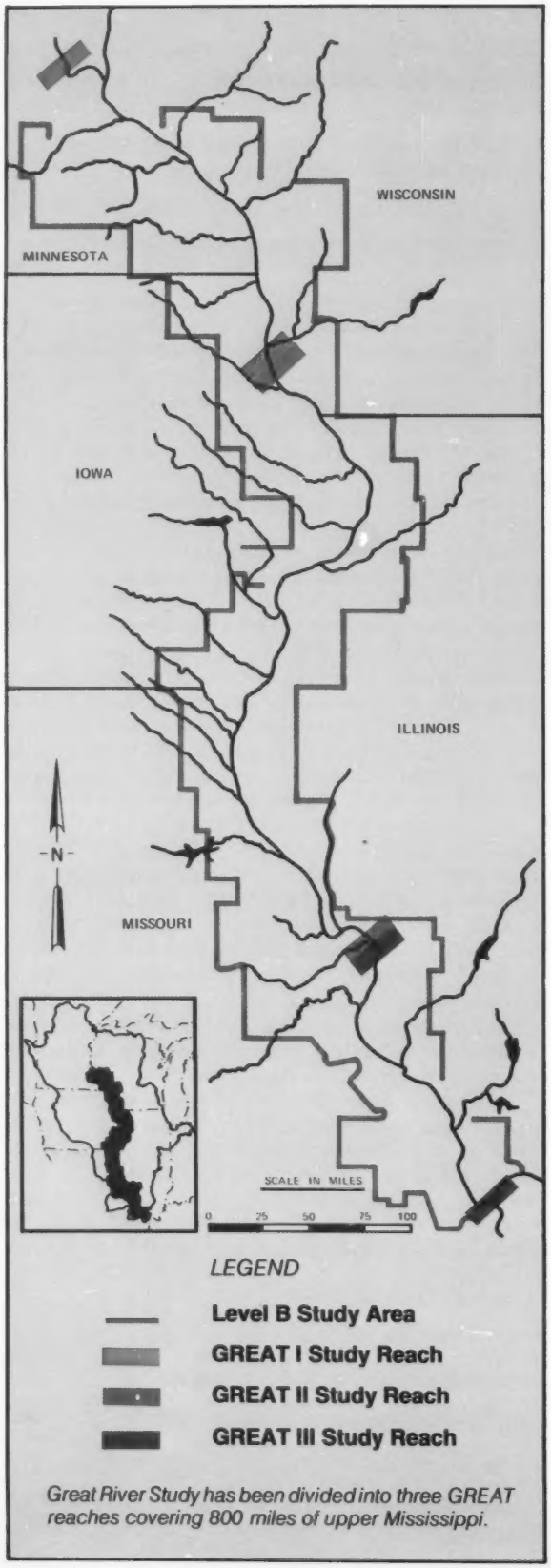
The paramount water resource of the upper Mississippi region is unquestionably the *Great River* itself. A true, yet finite multipurpose resource, serving and being served by an immense population, the upper Mississippi River is subject, however, to competing demands by many legitimate interests. Commercial interests tend to clash with recreational interests; preservation of pastoral and scenic values tends to compete with industrial and municipal uses. Where legitimate but competing demands are not harmonized, some interests risk losing the values they seek to maintain or having those values diminished.

For example, there is no doubt the 9-foot-deep navigation project in the upper river has been an economic boon to the Midwest. It is, rather, the influence of this project on the natural character of the *Great River* and the impact on many other river uses that has raised questions. GREAT, as a team, was created by the commission. GREAT, as a study, was conceived by multiple interests in the region for the purpose



Aesthetic value of this scenic reach can be destroyed by burying existing island vegetation under deposits of dredged material in order to extend beaches.

One of GREAT pilot programs is to stockpile dredged sand for commercial and municipal use. Minneapolis designated this site for its own needs.



Great River Study has been divided into three GREAT reaches covering 800 miles of upper Mississippi.

of developing a comprehensive plan for the 800-mile-long upper Mississippi—extending from the head of navigation above the Twin Cities of Minneapolis-St. Paul, Minnesota, to the river's confluence with the Ohio at Cairo, Illinois.

GREAT as a team is at work on GREAT the study, painting a planner's triptych of the upper Mississippi River in broad environmental strokes from Minnesota to Missouri to Illinois. This three-part GREAT River Study began as a result of widespread public concern for many values being overlooked by the traditional governmental deference to economic values in maintaining the upper river's navigation lifeline.

The northernmost navigable reach, from Minneapolis to Guttenberg, Iowa, is being studied by GREAT I. This part of the Great River Study is nearly 2 years into its program. The middle reach, extending to the mouth of the Missouri River at Saverton, Missouri, is under study by another team, GREAT II. The lower third, between Saverton and Cairo, will be studied by Great III. At the conclusion of the study, each of the three will have submitted its recommendations to the commission through the River Studies and Planning Management Committee, which was formed to coordinate the entire Great River Study.

All the recommendations are being organized according to the river-related issues being explored by 12 separate functional work groups. Each group is led by a GREAT member whose own agency or State program exhibits the most expertise in that particular area of inquiry.

GREAT Work Groups

Lead Agency	*Task*
Corps of Engineers	Dredging requirements
Corps of Engineers	Material & equipment needs
Fish & Wildlife Service	Side-channel openings
Fish & Wildlife Service	Fish & wildlife management
Soil Conservation Service	Sediment & erosion control
State of Wisconsin	Dredged material uses
State of Iowa	Recreation
Environmental Protection Agency	Water quality
Department of Transportation	Commercial transportation
State of Minnesota	Flood plain management
Upper Mississippi River Basin Commission	Public participation
GREAT	Plan formulation

Upper Mississippi is vital navigation waterway for Midwest. Barges fleeted here await towboats to push them south.

Organization of the Great River Study

Recommendations to the Administration and the Congress
Upper Mississippi River Basin Commission
River Studies and Planning Management Committee
GREAT I
Minneapolis, Minnesota to Guttenburg, Iowa
GREAT II
Guttenburg, Iowa to Saverton, Missouri
GREAT III
Saverton, Missouri to Cairo, Illinois

Three-part study recommendations will be forwarded to parent Upper Mississippi River Basin Commission at the conclusion of the study.

The stress placed on the upper Mississippi River for commercial purposes has been a sensitive matter of concern in the region for a number of years. The long-term focus on navigation derives from the congressional authorization to create a 9-foot channel, bringing with it very visible modifications. Today there are 29 lock and dam structures used to impound navigation pools along the channel between Minneapolis and Cairo. Although the actual navigation channel maintained through annual dredging programs occupies only a fraction of the study area's waterscape, disposal of its dredged material affects thousands of natural and manmade islands, hundreds of square miles of marsh, back channels, sloughs and flood plain lakes adjacent to the channel. Furthermore, most of this water resource created or enhanced by the navigation pools is designated as Federal Fish and Wildlife Refuges,[1] established by Acts of Congress in 1924 and 1958.

For many years conservation organizations, commercial fishermen, biologists and sportsmen have expressed deep concern over the methods used to operate and maintain the navigation waterway system on the upper Mississippi River. Their concerns were directed toward the U.S. Army Corps of Engineers, the agency assigned to carry out the navigation mandate for the Congress. The Corps was fulfilling its mission as Congress had directed, maintaining commercial shipping on the upper Mississippi River, and was doing so at a very low cost to the taxpayers. Those interested in broader

[1]The Upper Mississippi River Wildlife and Fish Refuge and the Mark Twain National Wildlife Refuge occupy more than 129,000 acres in the upper Mississippi valley. There are 8 Federal refuges and 16 State game management areas totaling 266,000 acres along the upper Mississippi River.

aspects of the river contended that other uses, including the goal for fish and wildlife management established by Congress, were legitimate uses which had to be recognized along with commercial navigation.

Meanwhile, requirements of the National Environmental Policy Act (NEPA) added emphasis to this dialogue and, in early 1974, the Corps of Engineers prepared environmental impact statements describing the effects of its navigation program on the upper Mississippi. These documents revealed that current methods of channel maintenance, especially the dredging and depositing of dredged material, were causing significant damage to the environmentally fragile backwaters, marshes and sloughs in the upper Mississippi region. The statements also revealed how little information was available, a factor that made it almost impossible for Congress or any government agency to evaluate management alternatives concerning the river.

During review of these statements, a Federal judge granted a temporary injunction requested by the State of Wisconsin prohibiting the dredging or depositing of dredged material in that State, except under emergency conditions, until the Corps had filed a final environmental impact statement with the Council on Environmental Quality in Washington, D.C. Many shippers and barge-line operators feared this action could result in closure of the channel to commercial traffic because of the resultant constraint on the Corps' dredging program. All interests agreed that stoppage of navigation could cause serious economic problems for much of the upper Midwest.

In the spring of 1974, Congressmen from Minnesota and Wisconsin supported a request to provide the Corps with extra funding with which to reexamine the environmental effects of its channel maintenance practices. The Congress approved funds to begin the program in fiscal year 1975.

Following this expression of congressional interest, the Corps and the U.S. Department of the Interior jointly requested the Upper Mississippi River Basin Commission, of which both agencies are members, to establish a study program with the ultimate objective of evolving a balanced management strategy for multipurpose use of the river. Because a committee on dredging already existed within the commission, the next logical step was to broaden that committee's scope and jurisdiction. By consensus, the chairman was authorized to form what came to be known as the Great River Environmental Action Team or GREAT.

Since the first phase of the Great River Study encompasses the upper third of the river, GREAT I is made up of appointees selected from representatives of the States of Iowa, Wisconsin and Minnesota, the U.S. Fish and Wildlife Service of the Department of the Interior, the Corps of Engineers, other Federal water resource oriented agencies, and ex-officio members from the Minnesota-Wisconsin Boundary Area Commission and the Upper Mississippi River Conservation Committee. Special interest groups, including the Sierra Club and Upper Mississippi Waterways Association, serve in an advisory capacity.

The central focus of the Great River Study is the need to identify and resolve conflicts resulting from separate legislative actions of Congress that decree this river is to be managed in the national interest not only for the benefit of commercial navigation but also for fish and wildlife purposes. Although the upper Mississippi represents the only area in the heartland of the United States where these dual objectives of maintaining national fish and wildlife refuges and a major inland navigation waterway coincide, there are instances of similar circumstances involving the Atlantic and Gulf sections of the Intracoastal Waterway. It is not unprecedented, therefore, to use special dredging practices to help maintain a proper balance between these same two objectives on an inland waterway as well.

Since the effects of channel maintenance practices on the adjoining fish and wildlife habitat are still being studied by GREAT, the results of the ongoing Dredged Material Research Program at the Corps of Engineers Waterways Experiment Station in Vicksburg, Mississippi, are being monitored to avoid any duplication. This coordination effort should produce an array of channel dredging alternatives that are both economically and environmentally acceptable, and have the potential to create manmade benefits from the dredged material.

Uncontrolled disposal practices permit dredged sand to drift into backwater sloughs, creating riverine deserts.

Another GREAT objective is to preserve existing migratory waterfowl nesting and feeding habitat without compromising other river management requirements.

Not only is every resource discipline, from geomorphology to ecosystem analysis, being applied to the study of this complex river system; it is also the first truly coordinated State-Federal study program on the river, and perhaps in the Nation, where the public has been involved in the program from the outset. GREAT is presently devising new techniques to bring the public into the preparation of long-term recommendations for managing the river as a resource.

GREAT I carried questions about the river's future directly to the people by asking local communities and organizations to cosponsor a series of town meetings along the GREAT I reach of the river. The first series of town meetings was held in January 1975 in the cities of Wabasha, Red Wing and Winona, Minnesota; Prescott and LaCrosse, Wisconsin; and Lansing, Iowa. Each town meeting served the dual purposes of explaining the GREAT study to the people and, in return, learning of their concerns for the river. A record was made of the public's concerns, each of which was turned over to the individual work group best suited to addressing that particular issue.

At LaCrosse, a representative of the Sierra Club read a statement critical of previous dredging practices for choking off aquatic life in the backwaters. At Prescott it was strongly felt by a person speaking from the floor that any management plan under consideration should balance recreation, wilderness and commercial uses of the river. A citizen at Red Wing advised GREAT to apply more erosion control measures in order to reduce the amount of dredging necessary. At Lansing the GREAT members heard that blocked side channels need to be opened and, at Winona, that some backwaters should be closed to create still water for winter fishing.

The dialogue at the town meetings could be characterized as a combination of specific proposals, counterproposals and probing questions. Exasperation over the proliferation of government authorities working at cross-purposes mixed with humor as GREAT I sharpened its communication links with the citizens who know and love the Mississippi.

GREAT I was deeply influenced by citizen attitudes in the formative stages of its work and adjusted its planning in recognition of the new alliance between the citizens and the team members, which became even stronger during the second series of town meetings in October and November 1975. This followup series provided a forum in which the team members could report back to the citizens midway through the study. Followup activities also appeared in *Soundings*, the newsletter established by GREAT to report its progress.

The second series of meetings was held in Lake City and St. Paul, Minnesota; McGregor, Iowa; and LaCrosse, Wisconsin. When it became apparent that management decisions resulting from the study would affect areas beyond those in proximity to the river, two additional meetings were held in November at Mankato and Montevideo, located in the hinterlands of southwestern and south central Minnesota.

The demonstration and pilot programs for improved channel maintenance practices and environmental restoration have been of particular interest to the public. For example, sand dredged from the channel is rapidly becoming recognized as a useful resource for fill and construction material rather than a disposal liability. GREAT also has demonstrated the feasibility of completely removing dredged material to sites beyond the immediate bounds of the navigation pools.

A good example of the innovative programs being conducted by GREAT is the recently completed study of Weaver Bottoms, a backwater slough on the upper Mississippi near its confluence with the Zumbro River in Minnesota. This study shows that the swamp is receiving increased flows from the Mississippi and Zumbro Rivers, eroding the inlet areas and deepening the backwater area.

It is a widely held belief that an ailing backwater can usually be improved by opening up its inlets on the upstream side, especially where they have been plugged by dredged deposits. This is not the answer for Weaver Bottoms, where the excess of flowing water is materially degrading the aquatic habitat by increasing rather than decreasing the open water area. Suggested improvements include construction of a rock dike to restrict the flow of water entering the upper end of the slough and establishment of a series of barrier islands to protect Weaver Bottoms from wave action induced by southeasterly winds.

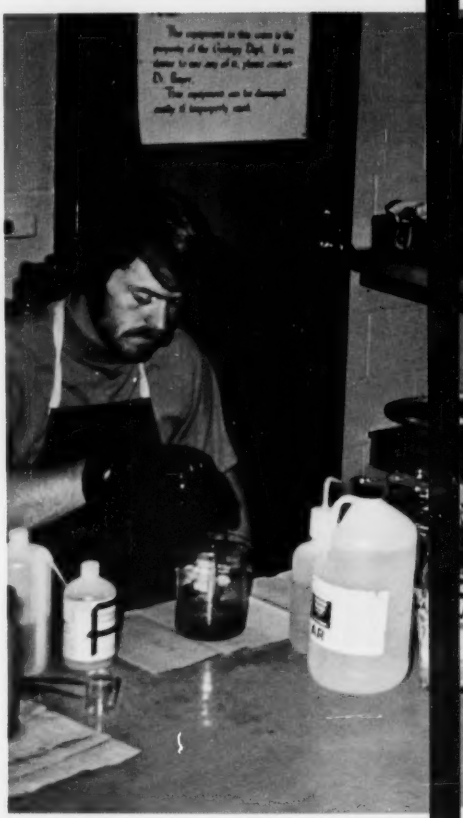
The new barrier islands, created from dredged deposits of sand, would be built to a height well above flood stage, with their shorelines protected by a rock riprap. The riprap would prevent subsequent wave action from eroding the new islands by carrying the sand back into the slough. Each island would receive a final cover of river mud with which to hold the sand-tolerant types of vegetation that provide nesting cover for waterfowl. GREAT has worked closely with the management agencies involved in implementing its demonstration and pilot programs.

A major area of inquiry has been to determine if dredging quantities can be minimized without increasing the risk of channel closure to navigation. In this regard, the optimum depth of dredging has been the subject of extensive review by GREAT. Identification of many sites where reduced dredging depth is feasible without significantly affecting the integrity of the navigation system is possible. GREAT is evaluating historic dredging requirements at each dredging site and implementing field programs to test theoretical river engineering recommendations based on river geomorphology and hydraulic principles.

At the recommendation of GREAT, the Corps of Engineers has contracted for the services of a riverine consultant engineer to provide guidance on dredging depth selection. Of 24 sites considered for maintenance in 1975, excluding small-boat harbors, 7 were dredged to 13 feet, 10 were dredged to 12 feet, 6 were dredged to 11 feet, and 1 site was not dredged at all. Some 700,000 cubic yards of material were dredged in 1975 under this reduced depth pilot program. If all the sites had been dredged to a depth of 13 feet, 985,000 cubic yards of dredging would have been required, 20 percent more than the volume required at 11 feet.

Of 18 sites considered for dredging in 1976, 6 were dredged to 13 feet, 4 to 12 feet, 6 to 11 feet, and 2 sites were ignored. This plan reduced the dredged material by 27 percent. The results of this reduced-depth dredging program will be closely monitored over several hydraulic cycles to determine its actual effectiveness.

Riverine consultants have also suggested that dredged material might be placed in the pools on the outside of river bends as an alternate method of material placement that



Extensive sediment analyses indicate biological character of aquatic habitat within study area.

could minimize the impact of dredged material disposal. This recommendation is based on the fact that during high water the pools on the outside of river bends deepen from the river's scouring effect while the crossover areas between the bends form shoals. The reverse process occurs during low water periods, but at a substantially reduced rate.

A reduction in dredging quantity would obviously reduce the environmental impact of material placement and improve the economic feasibility of introducing alternate dredging and material handling systems. In cooperation with the city of Minneapolis, for example, the Corps of Engineers was asked to conduct a pilot demonstration program in Pool 1 in 1975 to test the efficiency and effectiveness of barging dredged material to a beneficial use site while, at the same time, meeting local environmental objectives. A part of the river in this metropolitan area passes through a scenic and undeveloped gorge where past channel maintenance practices, the subject of severe public criticism, had been to place the dredged material along the adjacent river banks. Under the demonstration program, the material was dredged into dump scows instead and barged to an old municipal coal terminal, where it was stockpiled for use as fiil and for sanding icy Minneapolis streets in winter.

The pilot program demonstrated that this type of operation is logistically feasible and that the demand for the dredged material in the Minneapolis area exceeded the supply. In addition, the normal dredging requirement of 212,000 cubic yards in this area of the river was reduced to 136,000 cubic yards by lessening overdepth dredging. Furthermore, not placing the dredged material on the flood plain, where high spring flows could transport some of it back into the channel, is another reason to hope that this practice will continue to reduce future dredging quantities.

Data gathered through the town meetings, by the work groups, the surveys, the studies and other methods will be used in devising a new management plan for the Mississippi River. All of this data is being forwarded to the River Studies and Planning Management Committee, which was set up to coordinate all of the commission's river programs, including the GREAT study. It will be the committee's task, upon conclusion of the three-part study, to recommend the final plan to the commission.

GREAT I, still in progress, is unquestionably a success, particularly in terms of improving public/private relations. As GREAT II gets underway, the commission expects the partnership between government and citizens to be extended into the middle reach of the upper river. Finally, when GREAT III is established and funded, the entire upper Mississippi River will have been covered by the Great River Study.

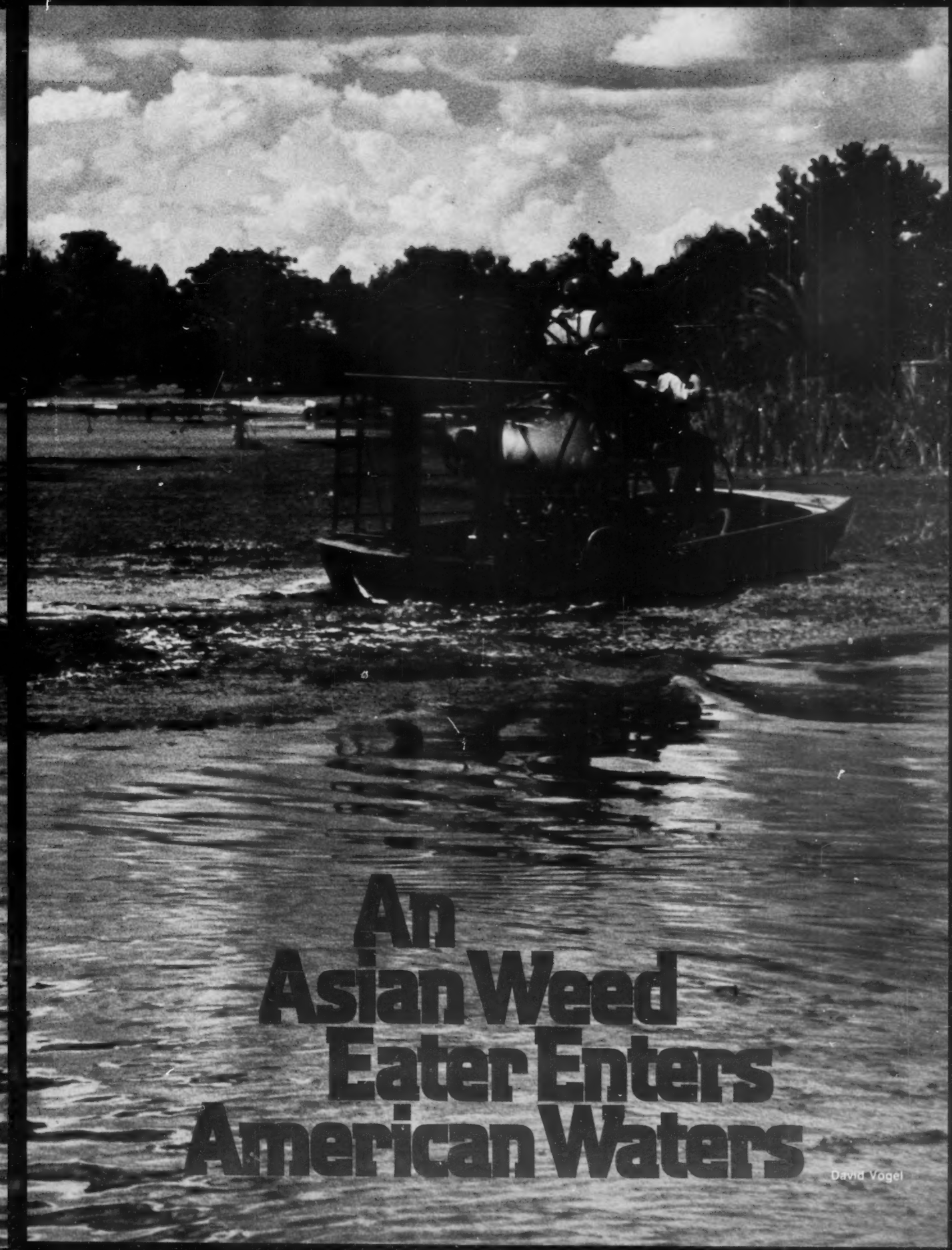
Meanwhile, the three team programs must be blended and integrated with the many other studies being conducted in the entire basin, since the river cannot stand apart from the region through which it flows. Therefore, the commission is initiating its long awaited Level B study for fiscal years 1977 and 1978 on the entire valley in which the river lies.[2] The 2-year Level B study will incorporate all GREAT programs, blending their outputs with the results from other completed and ongoing water resource programs. The product will be a comprehensive coordinated joint plan (CCJP) for development, management and conservation of the water and land resources of the river valley. More than a river plan, the Upper Mississippi River CCJP will represent the river valley portion of the commission's long range regionwide CCJP. To be completed by 1979, the regionwide CCJP will set the priorities and spending programs for managing the multistate region's water and land resources for many years to come.

Given the economic, environmental and social impacts of the ultimate planning products, it is important to reflect upon the grass roots nature of the building blocks of our programs. The Great River Study, characterized by an innovative alliance between the public and government, should serve as the prototype for ever expanding commission programs. GREAT points the way toward a balance between man and his entire social, economic and natural resource environment in the upper Mississippi River basin.

The GREAT programs are coming from the hearts of a concerned and sensitive citizenry. Combined with an entirely new approach to establishing priorities, goals and objectives, this has created what many have recognized as a *New Imperative* based on mutual responsiveness from the public and from officials. GREAT programs and policies are providing the underpinnings for the improved planning and coordination of activities for one of the world's mightiest rivers, the upper Mississippi. ■

[2]Level B represents a basinwide, interagency study of the upper Mississippi's water and related land resources that will serve as a general guide for the more detailed projects to come out of the GREAT programs.

J. Van Dyke



An Asian Weed Eater Enters American Waters

David Vogel

The following account of local participation in underwater weed control is supported by Corps of Engineers researchers. Aquatic weeds contribute to problems of maintaining southern waterways free of hazards to navigation, which is a responsibility of the Corps.

Two boats from the Orange County Pollution Control Board ride at anchor in the Florida sunshine beaming down on Lake Conway at the outskirts of Orlando. The surface stillness of the August day makes it easy to watch the divers at work 3 feet below, busy mooring sets of bright red marker buoys the size of volleyballs. This is how the first large-scale field test of a new biological weapon begins, by establishing a subsurface control grid that will not interfere with boaters and skiers.

The reason for the test is the heavy infestation of at least 10 percent of Florida's waterways by hydrilla, a subsurface aquatic weed whose origin is unknown. Not exclusive to Florida, dense underwater growths of hydrilla have become a hazard to boaters and swimmers throughout much of the South.

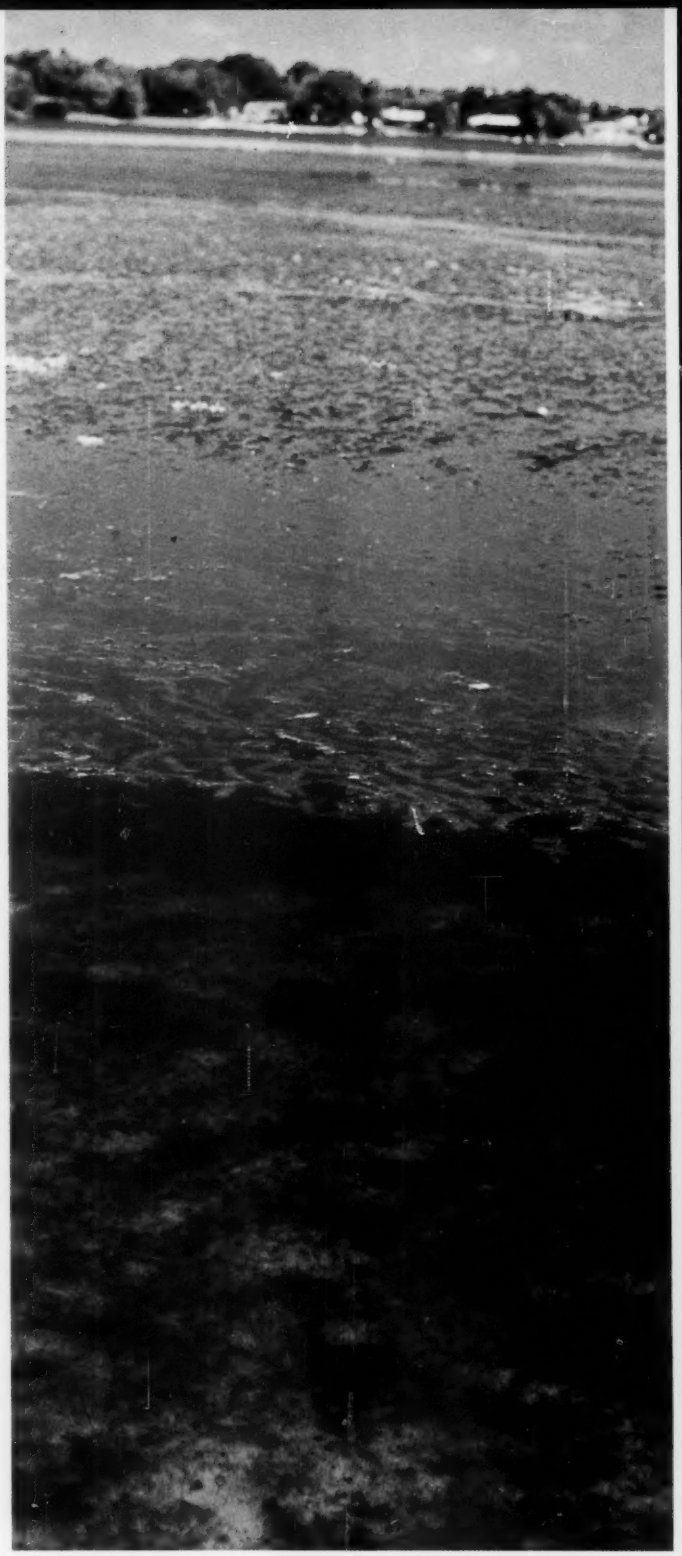
The biological weapon the Lake Conway test team has in mind is a fish called the white amur *(Ctenopharyxgodon idella* Val. *)*, often referred to as the grass carp. Originally brought in from the Amur River in northeast Asia, from which it derives its name, the amur's actual coloring is more a tarnished silver. As the largest member of the minnow *(Cyprinidae)* family, the amur more closely resembles the carp in size. Powerful comblike teeth, set deep in its throat, make it a voracious vegetation eater.

Release of the white amur into Lake Conway will come several months after the laying out of the underwater grid system. First, baseline data—such as the existing water chemistry, benthic organisms living on the lake bottom and current fish population—will have to be collected. The control grid merely helps organize the lake into identifiable underwater areas for data collection.

Nick Sassic, supervisor of aquatic weed control for the Orange County Pollution Control Board, reinforces the seriousness of the Lake Conway test by estimating that the State of Florida alone is spending between $5 and $6 million every year just to combat the spread of aquatic plants. That outlay, he adds, is destined to become much larger unless, of course, the white amur realizes its potential as a weed-eating control agent.

As his motorboat passes over the shallow lake bottom near shore, Sassic points out the presence of waving strands of hydrilla below the surface. Plucked from the water, a mass of hydrilla plants resembles limp green spaghetti sprouting tiny triangular leaves.

Its resistance to most herbicide treatments can be attributed to hydrilla's method of reproduction. The root system of each plant may extend down to 18 inches below the lake



Dense underwater growths of hydrilla in southern waters defy most herbicide treatments.

Mr. Vogel was a summer intern at *Water Spectrum*. He has since returned to the University of North Carolina at Chapel Hill to pursue a master's degree in journalism.

bottom. Each root forms tubers along its length that can, in turn, sprout new submersed plants. Dense growths of hydrilla may contain as many as 5,000 propagules[1] per square foot. An entire new colony, in fact, may start from a single fragment in circumstances where, perhaps, a passing boat propeller chops off a piece of hydrilla and transports only a minute section to a new area. Fragments of hydrilla also can withstand long periods of dehydration until proper moisture conditions permit them to sprout new colonies of their own.

Over 100,000 acres of Floridian waterways have been infested due to hydrilla's ability to be transported so easily. Hydrilla has the additional advantage over other aquatic plants of being able to photosynthesize with less sunlight, giving it what amounts to a longer growing day in the competitive world of plants. Furthermore, this ability allows hydrilla to grow at greater lake depths than is possible for other aquatic plants of a higher order in the botanical world.

Frequent sprayings with herbicide have been able to do little more than periodically check the growth of this prolific plant. Obviously, some weapon with a longer lasting effect is needed, which eventually led to consideration of the white amur as a possible tool for managing hydrilla.

Controversy over this fish's impact on aquatic ecosystems, however, remains a delaying factor in its use, even though the amur has been in the United States since 1963, when the U.S. Department of the Interior first stocked its Stuttgart (Arkansas) Fish Farming Experiment Station with it. The purpose was to study the amur's value as a weed eater. Biologists found out that the amur does indeed eat weeds and other organic matter in the water, but never attacks other fish in its adult stage, which had been a question in the minds of game fish authorities. The only real question remaining after all these years concerns the long-term effect of permitting large numbers of amur to graze at will on lake and river bottoms.

[1] Plant units capable of vegetatively propagating themselves.

This fistful of hydrilla plucked from Lake Conway illustrates the prolific growth that frustrates fishermen and makes swimming and boating difficult.

Powerful, comblike teeth enable the white amur to grind underwater plant matter against its hard palate.

J. Van Dyke

Another problem may be a result of the fish's extremely short digestive tract, since this does not permit it to fully digest more than a portion of what the amur eats, the rest being deposited as fecal waste. On the other hand, the portion of the plant food fully digested by the amur is converted into a firm, white meat that is high in protein and rates a close second to red snapper in taste tests. Russia and China, which share the Amur River, raise amur on fish farms as well as harvesting it in its natural habitat for human consumption.

The Corps, however, is more concerned with providing weed control than introducing a new food fish to American waters. Some of the amur's severest critics, in fact, are fishermen. They insist that research conducted at Auburn University in Alabama indicates the amur, or grass carp, is akin to the common carp, which tends to destroy breeding grounds for other fish by eating all the vegetation. Bass, in particular, it is pointed out, require the cover provided by aquatic plants to protect their young. This is one of the major concerns in the Lake Conway study, which the Corps is supporting with its research expertise and funding.

The Arkansas Game and Fish Commission contends that excellent fishing still exists in that State despite the release of 400,000 amur over the past several years, and that no public lake in Arkansas still has a submersed weed problem that can be considered serious. Jim Molone, who spawns and raises amur at his commercial fish hatchery near Lonoke, Arkansas, responds to the opposition by explaining that there is no record of the amur reproducing naturally in American waters; therefore, should the fish become as much of a pest as the weeds it eats, it will eventually die off if stocking is discontinued.

The Corps of Engineers is the lead agency participating in the Lake Conway field test with State and local agencies in Florida. The Corps has designated its Waterways Experiment Station (WES) at Vicksburg, Mississippi as its lead laboratory for the Nation's Aquatic Plant Control Research Program. This program is being managed by the Aquatic Plant Research Branch at WES under the direction of Lewis

Decell. Since the Jacksonville District of the Corps covers the State of Florida, this district office has the authority for coordinating with WES on behalf of the Corps, which has also published a brochure about the "White Amur in Lake Conway" that is available to the public.

Although optimistic about the amur's value as a weed eater, scientists at WES feel there is not enough information available on the amur's introduction to American waters. Among the States, only Arkansas has chosen to release the amur statewide without prior experimentation into the long-term effects.

Prior to the current Lake Conway exercise, there had been no large-scale tests run on the amur as a management tool. Lake Conway, with its 1,800 acres of water surface, is large enough to provide a more realistic test than those conducted within the confines of laboratory tanks, golf course water hazards or smaller lakes that do not have inlet and outlet streams similar to those entering and leaving Lake Conway.

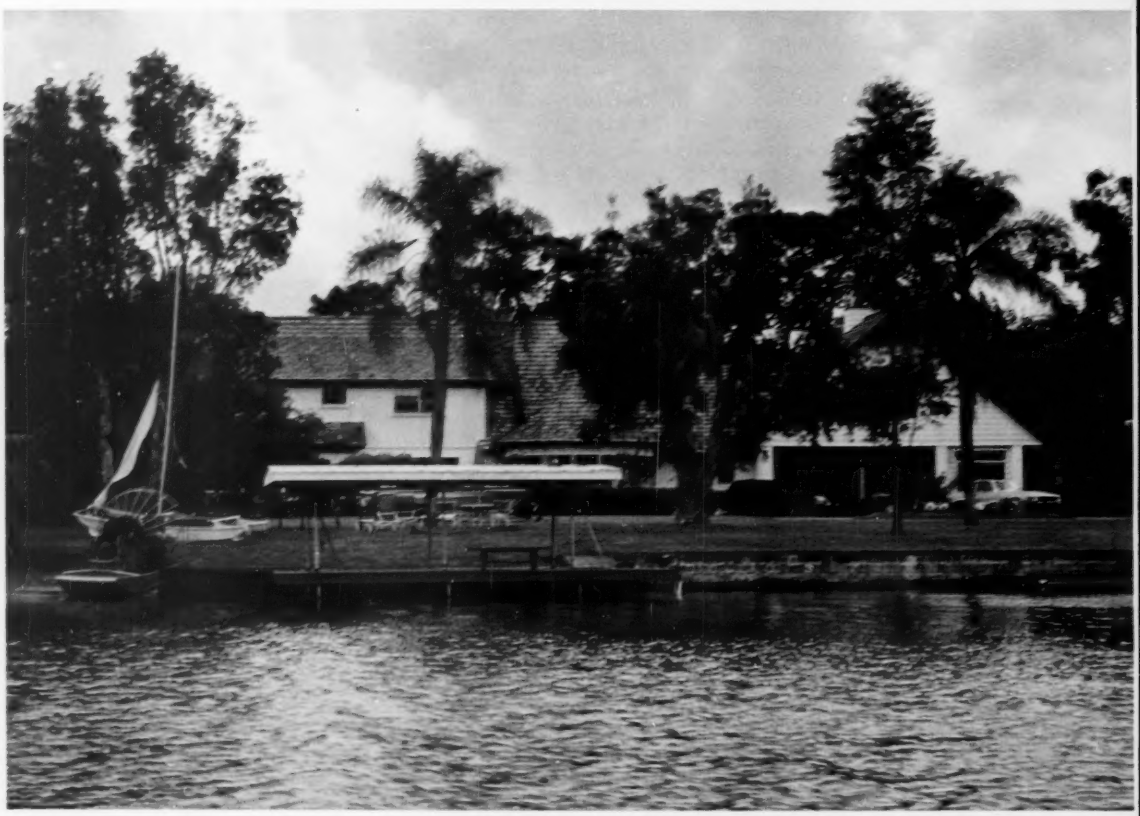
The idea of the Lake Conway experiment was conceived early in 1975. As Bill Rushing of the Aquatic Plant Research Branch at WES explained: "We're not trying to sell the fish, all we're trying to do is to see if we can use the white amur as an operational tool for weed control."

There have been conflicting reports of how high the hydrilla is located on the amur's food preference list. Pointing to an empty aquarium on a table in his office, Rushing recounted an incident in which he personally had observed a demonstration of the affinity of the amur for hydrilla. "I took a strand of hydrilla, wrapped it inside some strands of another weed, and threw it into the tank. The fingerling amur picked through the other weed and went for the hydrilla."

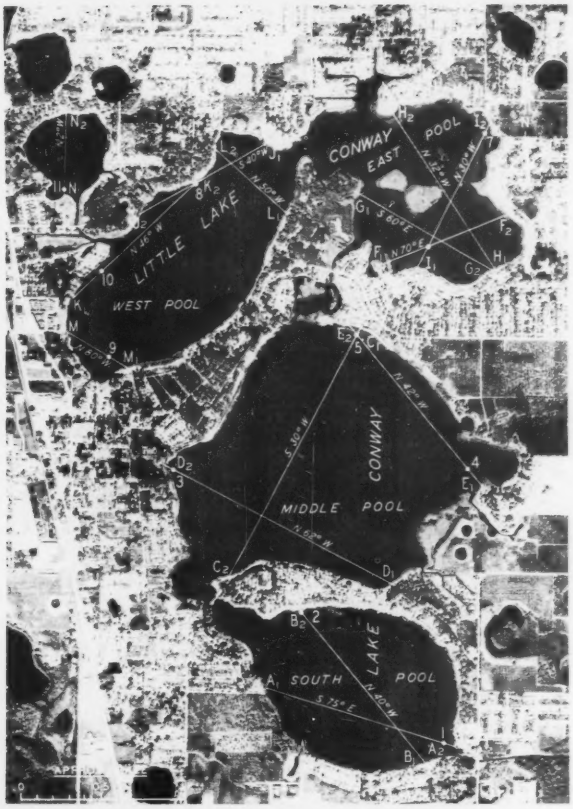
The general outline of the Lake Conway experiment was put together late in 1975 at a meeting of Federal, State and local agencies and universities held in Jacksonville. Monitoring of the lake's ecosystem was at that time divided into four main parts. Selected microorganisms would be monitored by scientists from the University of Florida, the lake's plant life by the Florida Department of Natural Resources, fish and wildlife by the Florida Game and Freshwater Fish Commission, while changes in the chemistry of the water would be by the Orange County Pollution Control Board.

The current part of this experiment is to establish baseline data, so that a differentiation can be made between normal seasonal fluctuations in flora and fauna and those effects, if any, caused by the amur. The experiment is to last several years, with each monitoring team taking monthly and other periodic samples during the entire period.

Amur will not be put into Lake Conway until some time in 1977, when the collection of baseline data will be completed. At that point the Corps will start to monitor the effects of this fish on the lake's ecosystem. A secondary, more local consideration is the obvious fact that without the adjoining open water—used for sport fishing, sailing and water skiing—the



Value of expensive real estate along shores of Lake Conway could decline if spread of underwater weed is not checked.



Transect lines display underwater grid system being used to organize test site into sampling areas for collection of baseline data.

surrounding real estate values would deteriorate as the beauty of the lake declined with the growth of hydrilla. Lake Conway was designated for the test by the State of Florida and agreed to by the Corps on the basis that its aquatic weed condition is typical of those which could exist in other lakes throughout the country.

Although Lake Conway is the State's first large-scale study, several other smaller Florida lakes have already been stocked with white amur. None of these projects, however, involved the extensive effort at data collection being conducted at Lake Conway.

The release of amur into these smaller lakes attracted considerable attention. Three television camera crews and two newspaper reporters showed up to cover the release of 300 fish into Lake Killarney near Orlando. Once was not enough for this lake, however, since the white amur fingerlings merely served as food for Lake Killarney's bass. Learning from experience, the State released husky 2-pounders into the lake for the second stocking.

While most agencies and researchers are cautiously optimistic about the amur's future, the Florida Game and Freshwater Fish Commission seems to be the only one directly opposed to the amur. Some of the commission's objec-

J. Van Dyke

Florida's Lake Bell, smaller than Lake Conway, was 90 percent infested by hydrilla before the white amur was introduced to its waters.

tions are based on the results of a project conducted at Lake Holden, also near Orlando. Possible overstocking at Lake Holden may have been the cause of such rapid feeding on hydrilla that the decaying dead plants released large quantities of nutrients into the surrounding water so quickly that the algae population in the lake multiplied many times over within a few weeks. As a result, Lake Holden turned into a thick green soup of algae.

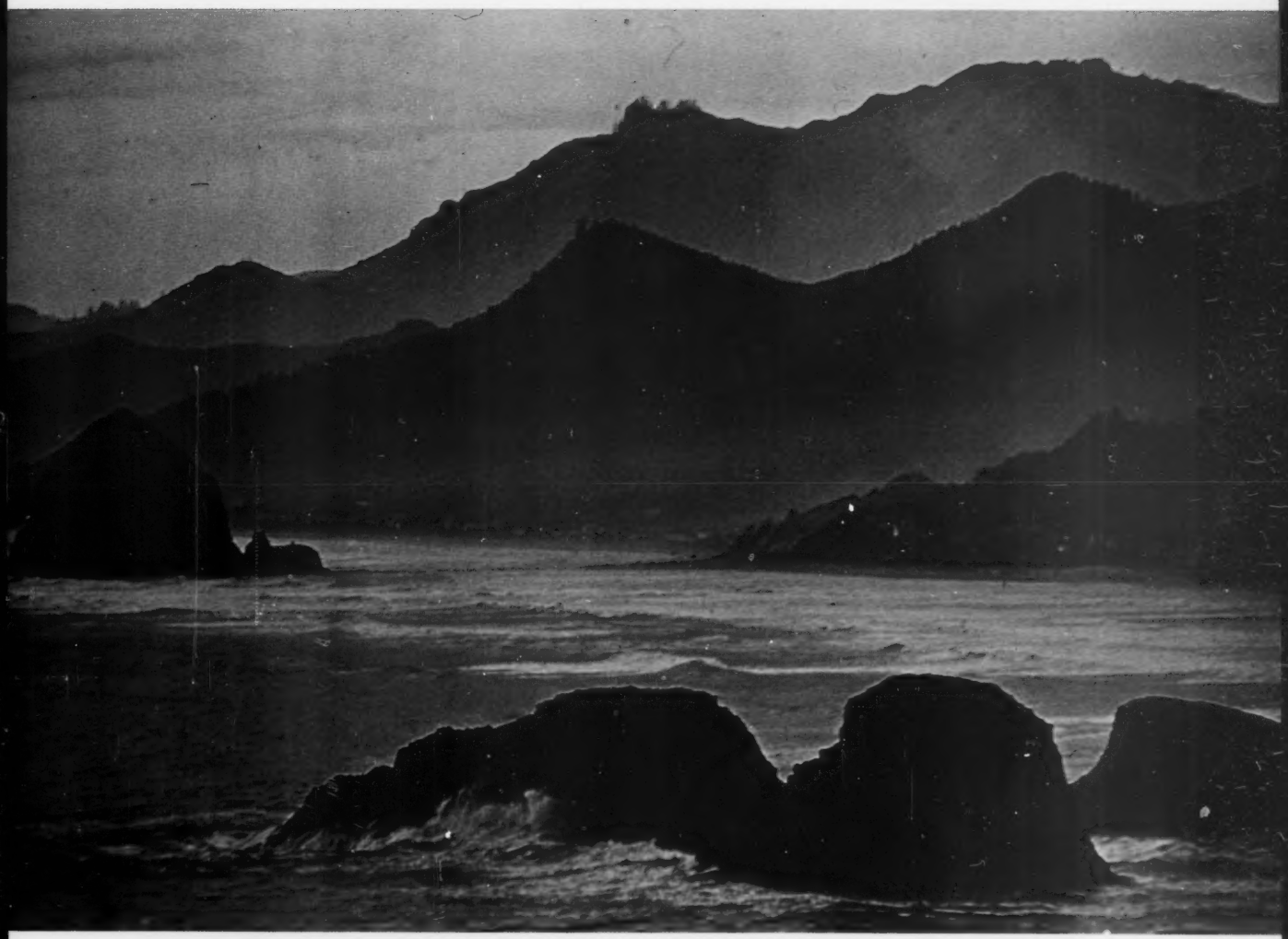
That is one reason why finding the correct rate of stocking, in terms of size and number of fish, has become one of the questions the Lake Conway test will seek to answer. WES hopes to develop a management program from the data collected at Conway to predict how many fish are needed to control a given volume of weed growth. The prescription will vary according to each lake's individual characteristics.

Another problem yet to be worked out is how to retrieve the fish when it becomes necessary to remove them from a body of water. Amur can grow to a considerable size and are quite powerful. They jump wildly when netted. Electrical shocking, seining, rotenoning[2] and other techniques have been tried without success in catching the bigger amur on a large scale. Obviously, this problem also will require some research.

Precautions planned for Lake Conway are intended to insure that none of the amur will be able to escape into the adjoining streams and that they will not be able to reproduce until the results of the experiment prove there is no danger to the sport fishing industry. Fish screens will be installed in both the inlet and outlet streams. In addition, only fish of one sex (female) will be placed in Lake Conway.

Despite the widespread infestations of hydrilla throughout the South, most of the States plagued by this aquatic weed do not want the white amur released in their waters. In fact, six of them have outlawed its use. Arkansas and Florida, on the other hand, are willing to gamble that the amur may turn out to be a "superfish" rather than a carp by another name. Not quite as liberal as Arkansas, however, Florida officials prefer the more scientific method of testing represented by the Lake Conway experiment. ■

[2]Chemical agent that prevents the absorption of oxygen from water through the fish's gills.



THE COAST: ACT II

by **Jill Pontius**

The Coastal Zone Management Act of 1972[1] had been enacted only a few months when the energy crisis created by the Mideast oil embargo forced Congress to consider amending the new law. The sudden energy shortage was focusing national attention on the outer continental shelf (OCS) where most of the country's oil and gas supplies are believed to be located.

Congress began examining ways to facilitate development of these resources. At the same time, it also wanted to help coastal governments deal with the considerable economic and environmental impacts which would inevitably result from expanded OCS activity. These requirements could best be met, Congress finally decided, by enlarging the Coastal Zone Management (CZM) Program already set up by the 1972 Act. The long legislative process ended in July 1976 with the President's signing the amendments into law.

The essence of the amendments is the financial impact assistance to States. The new act provides $800 million for loans and bond guarantees, $400 million for impact grants and $464 million for energy related planning and research and other additions to the coastal program. States also are

[1]See "Coastal Zone Management Act: A Broader Scope for State Initiative," Vol. 5, No. 1, 1973.

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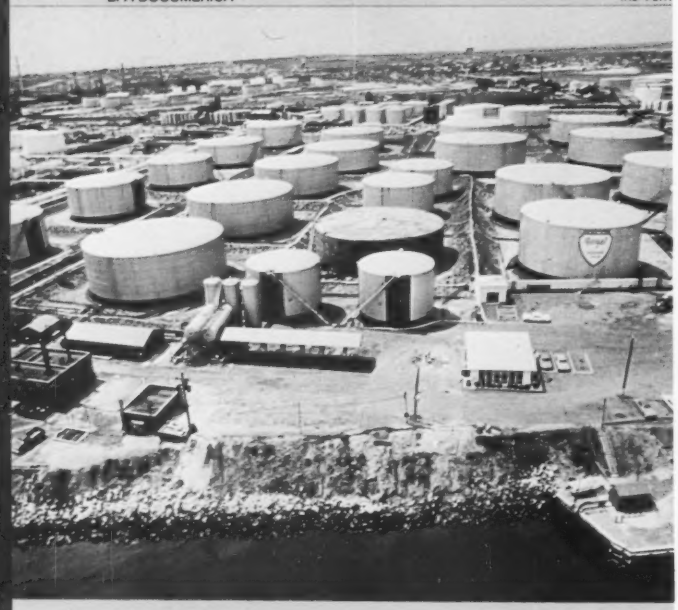

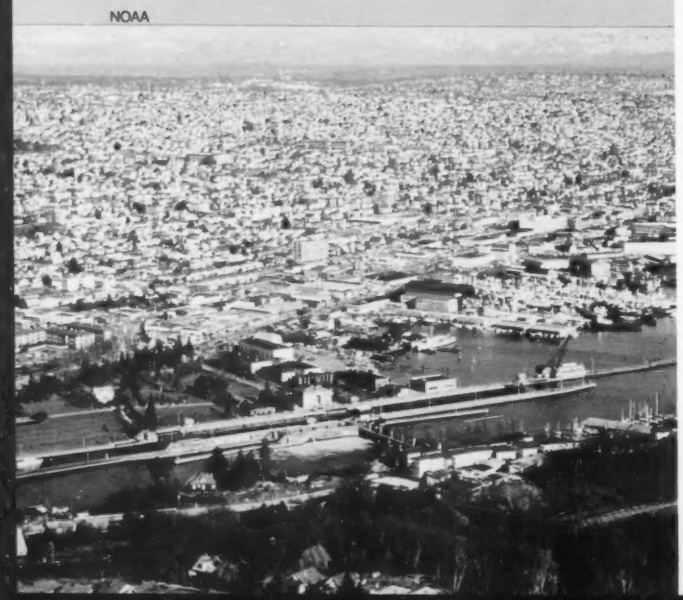

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given the authority to insist that proposed operations in leased OCS acreages adjacent to their coastlines conform to their coastal zone objectives.

Congress took this opportunity to legislate some program changes dictated by 3 years of experience.[2] One of the changes increases the Federal share of two key grant programs. Another puts greater emphasis on local levels of government. Additionally, several concerns not dealt with in 1972 are addressed in the expanded act.

The structure to which Congress affixed its incentives for offshore energy production—the CZM Program—is particularly suited to the task. Program personnel have been working with coastal governments for several years. Furthermore, its apparatus already is geared to the management of natural resources through financial assistance and a Federal consistency requirement. The program is designed to help coastal States and Territories, working with coastal communities, develop their own programs for managing finite land and water resources in coastal areas which they themselves have delineated.

Persons with interests as diverse as development and wetlands preservation, sewage disposal and swimming, and oil pumping and fishing are competing for coastal resources. Obviously, these uses are not always compatible. Yet they are legitimate practices and must be balanced, or managed, so that limited coastal assets can meet the many requirements made on them by the citizenry.

Specific locations are, of course, more familiar to persons in State and local governments. Management decisions, therefore, are left to the States who, in turn, are required to maintain consultation with local units. However, to receive the Federal money that will assist in developing and implementing their management plans, States must methodically complete the data collection, analyses, planning and coordination procedures laid out in the coastal management program.

The program is administered by the Office of Coastal Zone Management, a component of the National Oceanic and Atmospheric Administration in the Department of Commerce. Under the direction of Robert Knecht, the office provides States with financial and technical assistance and helps ensure Federal compliance with approved State programs.

Funds are distributed to States through three component grant programs established by the basic act. The first, au-

[2]Grant program funds were not appropriated until 1973.

Fifty percent of all manufacturing facilities are located in coastal counties.

The amendments require participating coastal States to prepare for onshore energy installations such as this New Jersey tank farm.

Aerial view of Seattle, Washington visualizes intensifying pressures along Nation's shorelines where some 8 percent of land contains 50 percent of the people.

thorized by section 305, involves a program of grants for planning and developing State management programs. The second type of grant, authorized in section 306, is for administering and implementing the State plans. These 306 grants cannot be given until the management plans are approved by the Office of Coastal Zone Management. The third grant program, authorized by section 312, is used for acquisition of estuarine sanctuaries.

The major thrust of the 1976 amendments, enacted because of national need to become self-reliant in domestic energy production, is directed at the expected impacts of offshore energy producing activity. Congress foresaw that expanded exploration, development and production of natural gas and oil in the outer continental shelf would inevitably require more energy facilities on the coast—refineries, tank farms, pipelines, for instance. Additional public facilities and services such as roads, schools and water supply would be needed to care for the new residents attracted to accelerating job opportunities. Rapid increases in population could affect natural land and water resources in the coastal zone.

Unless coastal communities could be assured of timely financial assistance in coping with these impacts, Congress believed that Federal plans for increased OCS energy production could very possibly be disrupted or delayed. It responded to this new situation by creating a fourth, $1.2 billion financial assistance program called the Coastal Energy Impact Program.

A combination of loans, guarantees and grants was devised to allocate the money to reassure inland States that real needs would be met in coastal States and yet encourage coastal governments to cooperate in quickly increasing offshore energy production. The new provisions take into

Primary impact assistance is administered by the Secretary of Commerce from an $800-million revolving account in the U.S. Treasury called the Coastal Energy Impact Fund. To qualify, States and Territories merely have to be supporting the objectives of the coastal management program.

The $800-million fund will be used principally for loans and bond guarantees to States to help them provide new or expanded public facilities and services to meet the needs of the energy industry. Whenever increased OCS energy activity results in a coastal State's inability to meet earlier loan obligations or in its loss of a valuable resource, 100-percent compensation grants also are authorized from the revolving fund.

When a State cannot benefit from loans and bond guarantees—perhaps not enough Federal funds are available to meet that State's new requirements—it may receive grants from a smaller, $400-million impact fund. These grants consist of 100-percent Federal funds allocated first for the retirement of guaranteed State and local bonds. These grants can also be used for either the study, planning and development of projects leading to new public facilities and services required by OCS activity or the prevention, reduction or amelioration of losses of natural resources.

These are called *formula* grants because they are based on four numerically based categories for each coastal State, calculated from the immediately preceding fiscal year, and compared to the category totals for all other coastal States. In this four-part formula, new *leasings* of OCS acreage are allotted a one-third share. The number of individuals who, as a result of new energy producing activity, obtained *employment* account for another third. The volume of natural gas and oil *produced* and the volume *landed* are each allotted a sixth. Production and landings are in separate categories because oil and natural gas may be shipped a long distance—from Alaska to California for instance—before being brought ashore.

Since development proposals involving leased OCS areas have to be submitted to the adjacent States for concurrence, it is in a State's own interest to process licenses and permits as quickly as possible to obtain a share of the money available. To save time, once a State has approved the proposed activity, any subsequent permit or license application required by that activity is also presumed to be consistent with the approved CZM program.

Exxon

Recent amendments to Coastal Zone Management Act provide financial impact assistance to State and local governments for outer continental shelf operations such as this oil drilling platform, 75 miles off Louisiana's coast.

account the increased State tax revenues expected to result from expanded OCS development.

Another new provision requires States to establish a planning process dealing with the siting of energy facilities such as nuclear reactors or refineries in their coastal zones. Siting decisions cannot be made by the Federal government. Supporting grants are authorized for the study and planning for impacts resulting from construction of these energy facilities.

While the energy shortage provided the impetus for amending the 1972 Act, the experience gained during 3 years of actually administering the coastal management program led to some modification of the original legislative structure.

One of these adjustments is a needed provision added to section 305 that is dubbed *305½*. It allows States to begin implementing portions of their CZM plans even before they receive final approval. This interim implementation is designed to give States time to complete action, a full review for instance, that is needed to make their programs operational.

In other section 305 changes, the appropriation is raised from a 1975 level of $12 million to $20 million over the next 3 years, beginning in 1977. The Federal share of development grants is increased from 66⅔ to 80 percent and four rather than three annual planning grants are now authorized.

An addition to the implementation grant program of section 306 places more emphasis on local government with a detailed definition of what constitutes an "effective" mechanism for continuing coordination with local governments. States are now required to give notice of any decision overriding a local zoning ordinance. The Federal share of administration grants is increased to 80 percent and the 306 funds authorized annually are raised from $30 million to $50 million.

To encourage unified coastal zone policies, interstate organizations now are permitted to enter the Federal CZM Program. These organizations will pay only 10 percent of the costs of their CZM related activities.

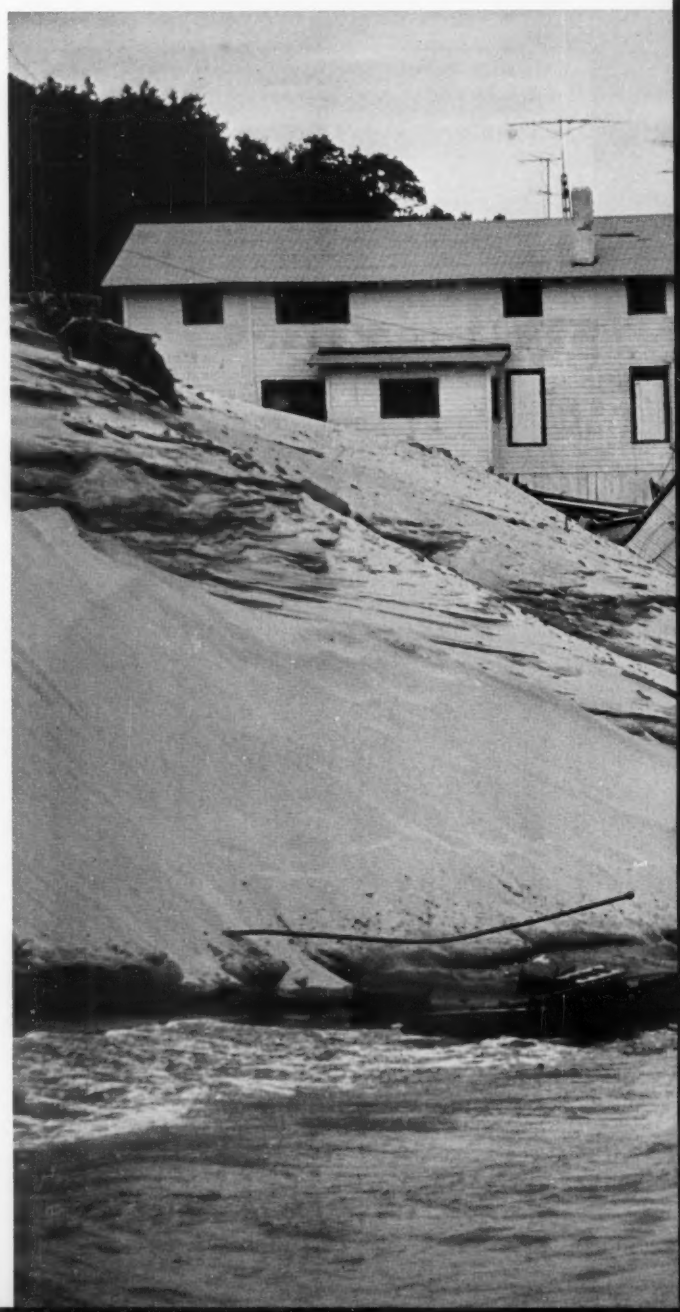
In the 1976 amendments, Congress also dealt with three situations that had grown more critical since 1972. These are coastal erosion, public access to beaches and shellfish contamination.

For several years concerned residents of the Great Lakes States, in particular, have watched the rising water levels washing away their lake front property.[3] Their problem was addressed by adding a requirement to section 305 instructing States to establish a process for assessing the effects of shoreline erosion, both natural and man induced. Although this type of erosion is most serious along the Great Lakes, all States are required to study and evaluate ways to control or lessen the impacts. They also must try to restore eroded areas.

During the 1970s, recreation-minded citizens have become increasingly vocal about obtaining more opportunities for outdoor activity. Their demands have been supported by action—annual increases in the number of people using the coast for recreation far exceed the population growth rate.

To help satisfy their needs, a matching grant authorization for the acquisition of public access to beaches and other public coastal areas was included in the 1976 amendments. As a condition for receiving program approval, States must define the word "beach" and submit in their plans a detailed procedure for protecting their beaches and providing the public with access to them. Islands are often fragile ecological units and funds are now authorized for their preservation.

Unease about shellfish contamination has been growing among consumers and fishermen alike. The Secretary of Commerce, according to another new coastal law provision, must review all aspects of the molluscan shellfish industry and evaluate the impact of Federal water quality law on the shellfish industry. The Secretary of Health, Education and Welfare must review the resultant economic analysis before



[3]Fluctuating water levels of the Great Lakes are discussed in "Loss Levels," Vol. 3, No. 4, 1971-72.

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Recent picture of Lake Michigan shore line illustrates why coastal erosion provision is included in newly expanded CZM Act.

issuing final regulations on the national shellfish safety program.

Concern, new energy needs and experience in administering the program all inspired a new section in the amended act called "Research and Technical Assistance for CZM." Forty million dollars over 4 years is authorized to assist State and local governments in areas where some are ill equipped to help themselves—the fields of data collection and personnel training. Half the money will be available to States for their own CZM analyses and training, with the States paying 20 percent. The other $20 million will be used by the Office of Coastal Zone Management to conduct national studies and training programs.

Nationwide data on OCS energy activity impacts—impacts on public facilities and energy installations, coastal ecosystems, recreation, agriculture and fisheries, for exam-

Federal funds are now authorized to acquire access to public beaches and other publicly owned coastal attractions.

ple—is being collected and analyzed by the office. States also are concerned about planning for hurricanes, flooding, earthquakes and other natural hazards and need information about them. Additionally, a substantial amount of technical data for shoreline inventories and legal authorities is flowing from the States into the Office of Coastal Zone Management where it is now being catalogued.

As the office completes its analyses, they will be sent to the National Technical Information Service in Springfield, Virginia for reproduction and distribution around the country.

The CZM Program has now been funded for 3 years. One by one, nearly all coastal States and Territories have applied for funding and begun the long, sometimes difficult process of compiling and incorporating into their programs the information necessary to gain approval.

This data must include the boundaries of the coastal zone to be managed with a definition of the land and water uses affecting the coastal zone that the State will permit. The means by which these uses will be controlled, through State laws for example, have to be identified and broad guidelines on the priority of the uses must be established. Existing State laws, by the way, often form the bases for initiating State management plans.

Inventories must be taken of those coastal zone areas that are of particular concern to the State or the Nation. These may include fishery areas, prime recreation land and flood plains. The 1972 Act also requires a description of the organizational structure which will administer the State's management plan. A State is expected to encourage its citizens to participate in its planning efforts.

Nearly all the States are currently in the 305, or planning, phase where various difficulties often materialize. Setting coastal zone boundaries along 100,000 miles of national coastline, for instance, is a formidable task. The act requires a balanced approach that will attempt to guide development to appropriate areas and restrict use of areas susceptible to environmental damage. Conflicts frequently develop over the rights of property owners to develop their land versus Statewide interest in preserving the coastal environment. Often delineated only after heavy debate in State legislatures, coastal zone boundaries thus far defined vary in depth from as narrow as 200 feet in parts of Washington to as wide as every county in North Carolina that touches the shore.

In an interview, a deputy director, Richard Gardner, said that exclusion of sufficient upland areas from the coastal zone has been a common deficiency found in proposed programs. A portion of uplands should be included in every coastal zone, he explained, if they affect coastal waters; upland drainage, for example, can have quite an impact on coastal flood plains. One State that avoided this omission was Oregon. It designated as its proposed coastal zone an area stretching from the 3-mile seaward limit inward to the first ridge of coastal mountains.

Another difficulty has resulted from an exclusion in the act that does not allow lands held in trust by the Federal government or lands under the sole discretion of the Federal government to be defined as part of a State's coastal zone. The States of Washington and Oregon wanted to include in their coastal zones the Federal lands over which they exercise concurrent legislative jurisdiction. Realizing that a legal determination was required, the National Oceanic and Atmospheric Administration requested an opinion from the Department of Justice. In August the Assistant Attorney General, Office of Legal Counsel, issued a letter stating that in his opinion the exclusionary clause in question excludes all lands owned by the United States from the definition of the coastal zone. Litigation could occur on this issue.

NOAA

Well-planned development of coastal zone is a principal aim of coastal management program, along with preservation of select areas.

A similar kind of disagreement often crops up when a description of the legal authorities of local, county, regional, State and interstate agencies is attempted. Every coastal State is conducting an analysis of existing legal responsibilities and interrelationships.

With the exception of American Samoa, all 34 coastal States and Territories have entered the 305 program, but only the State of Washington has completed this preliminary development stage. Its management program was approved in June 1976.

During 1977 Gardner expects that Oregon, North Carolina, the Virgin Islands, California and Michigan will also have completed the planning phase. The California legislature, after many months of debate, recently passed a comprehensive law to protect its 1,072-mile coastline.

In addition to the State level plans, regional programs exist such as that established by the San Francisco Bay Conservation and Development Commission. Already in operation for several years, Gardner predicted that its program would qualify for Federal approval and an implementation grant in 1977. The plan of the Culebra Island segment of Puerto Rico also is close to completion.

The all-important approval of its plan brings a State into the section 306, operational grant program. Thereafter, almost all development activity in its coastal zone, both private and public, must adhere to the policies of the State's coastal management program.

Management decisions are basically left to the States so Federal approval is based not on individual siting decisions but on the process the State has established to deal with such decisions. For instance, approval of Washington's plan was delayed earlier by the Office of Coastal Zone Management because it had not fully coordinated with the appropriate Federal agencies. Maine's application, on the other hand, was withdrawn because of that State's failure to consult with local governments. Once eligible for 306 money, States must maintain an ongoing review and consultation process with local agencies to maintain their eligibility for subsequent

Upon receipt of a State's application to enter the program operation phase, the Office of Coastal Zone Management follows a five-step approval procedure that takes about 7 months. In this process the office first reviews the plan and then prepares an environmental impact statement (required by the National Environmental Policy Act) from the information contained in the plan. In the third step the plan and impact statement, combined in a single document, are sent to interested Federal agencies for a 60-day review period. The office then discusses the reviewers' comments with the State, negotiating any differences. In cases of irreconcilable differences, the Secretary of Commerce—advised by the Executive Office of the President—is the final arbiter. Last, the revised plan and impact statement are distributed again to Federal agencies. Thirty days after distribution, the State program may be formally approved.

grants. In many cases, local governments actually operate the program while the State reviews it.

Program approval not only releases 306 money, it also triggers the Federal consistency requirement contained in section 307. This section gives States the authority to object to applications for Federal permits, or assistance, for activities or projects affecting their coastal zones which are inconsistent with their programs.

Conservation of wildlife is a legitimate use of the coastal zone that should be included in development programs.

NOAA

NOAA

National Park Service

Formulation of a State's coastal management program will help it achieve rational allocation of its own finite resources.

The Corps of Engineers, for example, is responsible for the issuance of dredging and disposal permits for the disposal of dredged material to persons under the River and Harbor Act of 1899 and the Federal Water Pollution Control Act Amendments of 1972. Section 307 of the CZM Act, however, specifies that no permit will be issued until the State has concurred in the proposed work or has later been overruled.

The applicant must notify the State of the intended activity and certify to the Corps that the work will be consistent with the approved State CZM program. The Corps forwards the certification to the State and awaits its decision.

By regulation, the State is required to publish a notice of each certification and must reply to the applicant within 6 months or its concurrence is presumed. A Federal agency can issue a permit, or provide assistance, over a State's objection only when the Secretary of Commerce finds the proposed activity to be either consistent with the purposes of the act or in the interests of national security. Views of the Department of Defense must be considered in the latter situation.[4]

The third grant program, authorized by section 312, gives matching grants to coastal States for the acquisition, development and operation of estuarine sanctuaries to be used as natural laboratories. So far, three grants have been made for sanctuaries at Coos Bay, Oregon; Sapelo Island, Georgia; and Waimanu Valley on the island of Hawaii. Eventually, the office hopes to help acquire sanctuaries in the 11 major geographic types of estuarine areas that have been identified. Under the new amendments this section also will be used to acquire access to publicly owned beaches, historical and other coastal attractions.

While controversy may sometimes surround land use decisions, most land use practices enjoy public support. People are concerned about the future and want to understand how alternative, large-scale uses will affect them: Will a use result in higher taxes? Change their incomes? Alter their environment?

Especially along the country's shoreline, the resource-sharing dilemma is intensifying. Enormous pressures are building there, for the Nation's coastal zone areas cover only 8 percent of the land but contain 50 percent of the population. The demands of recreation, transportation, farming, industry, fishing, environment, sewage disposal, preservation and development interests have now been joined by new energy needs. The recent energy shortages that focused attention on the offshore deposits of oil and natural gas as a source of supply have strained even further the ability of coastal governments to cope with the many requirements levied on their areas.

A solution to this dilemma of rational allocation of a scarce resource—the coast—is being sought with the aid of the CZM Acts. The coastal management program established by the legislation offers the opportunity of moving from an era of confrontation and litigation to a time of compromise and reconciliation—a period of thoughtful, cautious analysis. Hopefully the legislation will help to achieve a wise balance of uses in our populous coastal regions. ■

[4]Office of Coastal Zone Management regulations governing the consistency of Federal projects and programs were still in draft form at the time this article was written.

PRADO DAM GOES BICENTENNIAL

by **Lawrence Hawthorne**
Public Affairs Writer
Los Angeles District

For years the target of spray-can wielding vandals and misguided young poetasters, it stretched across the Southern California skyline like a giant cluttered concrete canvas—1,000 feet long and 100 feet high. It was an eyesore! It was the way Prado Dam used to look before July 4, 1976.

Built for flood control in 1941 by the Army Corps of Engineers near Corona, California, the Prado Dam spillway was a natural focus point for passing motorists who complained about the unsightly hieroglyphics. To make matters worse, the graffiti on Prado Dam that had become a local concern had also become a local tradition. A senior class custom among local high school students was a graduation night visit to the spillway for a spray paint declaration of new found independence.

Thanks to a small group of Corona High School students, this Bicentennial year things were to be different. In late 1975, Corona High seniors decided they should capture the spirit of the Bicentennial by painting the 100,000 square feet of the Prado Dam spillway from end to end and top to bottom in honor of the national birthday. They went to work by enlisting the help of more students and talking to civic leaders, school administrators and local service groups.

Although the students generated interest, they were unable to garner the solid commitments from groups or individuals necessary to get their project off the ground. When the project's leader bowed out in April to pursue a part-time job, the idea might have died then and there but for a petite blonde coed named Terri Smith who took the helm.

"It really started turning around for us when I told Mr. Deegan about our plan," recalls Terri.

A local businessman, Jim Deegan had been active in youth development programs and he took an immediate interest in

Project leader Terri Smith begins final touch of painting in Liberty Bell's crack.

the students' endeavor by putting Terri and her group in touch with others who could help.

This led to a phone call from Ken Redlin, the director of the Corona City Parks Department, to Bob Land of the Corps' Los Angeles District, asking Corps permission for the students to paint the spillway. Land, chief of the district's Operation Branch, was in a position to gain the necessary approval, but he didn't stop there.

"We liked the idea right away," Bob Land says. "Besides, keeping Prado spillway reasonably clean had become an impossible chore. We felt a great big Bicentennial design just might be the answer."

He arranged for the Corps to donate the paint needed for the project ("Ouch! I didn't know it was going to take 625 gallons."), and when the students needed a design he suggested they hold a contest. He also laid the groundwork for the Corps to judge the entries and contribute a $25 savings bond for the winning design. Jim Deegan chipped in with another savings bond.

Things were definitely looking up. Tables were set up in front of the Corona High School library to sign up volunteer painters. "No artistic talent required," read the sign. Paint rollers were donated. Buckets were gathered. Old clothing was rounded up to be used for rags. By the end of May all was ready.

"By that time," said Miss Smith, "it was no longer just a Corona High School senior class project, but had really turned into a community effort."

In the early daylight hours of the long Memorial Day weekend, about 40 young souls ascended Prado Dam. Three days and 400 gallons of white paint later, the spacious spillway had received its base coat. Free from graffiti for the first time in many years, the spillway's spotless condition was unfortunately short lived. Vandals struck again.

The setback was only temporary. Students returned the next weekend to paint over the latest Prado desecration. With the help of a commercial artist who donated his time they began chalking in the design. One more weekend of nose-to-the-concrete work and the mammoth mural was nearly complete.

It took 625 gallons of paint to do the job, but 2 weeks before the Nation's 200th birthday Prado Dam was sporting a colorful Bicentennial look. Painted in red, white and blue across the spillway were the words: "200 Years of Freedom," a representation of the Liberty Bell and the dates 1776-1976.

The Corps of Engineers sponsored a brief ceremony at the dam to honor the student participants. Civic leaders, sponsors and Corps representatives presented awards to the design contest winners and the student leader who organized the effort. In a fitting finale to the months of arduous work, the students added a crowning touch to the ceremony by gathering with brushes in hand, for the final time, to paint in the Liberty Bell's crack. ■

Events, Deeds & Deliberations

River Reveals Victim

The falling waters of the White River in Arkansas, reduced by drought to their lowest levels since 1937, recently bared the broken skeleton of the *New Mattie*—a 140-foot by 33-foot sternwheeler that disappeared three-quarters of a century ago.

The remains were discovered by Corps of Engineers workers during dredging operations. A North Little Rock assistant high school principal and local steamboat historian, Duane Huddleston, worked with Corps personnel in surveying, digging out, measuring and examining the rotting paddlewheeler. Huddleston then spent many additional hours researching records of sinkings and concluded that the exposed wreck was indeed the *New Mattie*.

According to news accounts of that era, the *New Mattie* was on her regular run downriver to Memphis on the evening of February 17, 1900 when she began taking water near Wild Goose Bayou, 12 miles from the entrance to the Mississippi River. Her captain, William J. (Billy) Ashford, ordered the sinking packet boat to be run aground on a sand bar; but the vessel careened on its side, sank in 18 feet of water and broke in half. Although all 35 passengers survived, 2 deck hands perished. Also lost was her cargo of 356 bales of cotton and 1,000 sacks of cotton seed.

The sternwheeler was in a delapidated condition when Captain Billy purchased her at Plaquemine, Louisiana. Known as *Hump Back Mattie* because of the hump on her hurricane deck, the captain rebuilt her into one of the prettiest packet boats on the White River and named her *New Mattie* for his daughter. From 1897 to 1900, the packet made 31 trips between Memphis and White River ports.

Salvaged during the *New Mattie's* month-long reappearance was a tiny brass postal scale, which is still in good condition except for a very rusty spring. Also salvaged was the boat's capstan. This winchlike device, made of live oak, was used to pull the paddlewheeler snug to the shore by tying the attached rope to a tree and turning the capstan round and round. Passengers and live stock could then comfortably disembark.

Following a 90-day preservation treatment, the capstan is being displayed in various places around the Little Rock District. The district public affairs officer has been contacted by representatives of several regional museums who would like to permanently display the capstan.

After several weeks of exceptionally low water levels, the Mississippi began refilling and the tributary White River began rising with it, once again hiding the *New Mattie* beneath its waters. Meanwhile, time and the river relentlessly continue deterioration of the once proud vessel until, perhaps, there will be no recognizable vestige remaining when next the river should chance to "drop out" again. ■

White River's falling waters expose skeleton of steamboat that sunk in 1900. Closeup shows details of wooden planking and struts of paddle wheels.

No Fuss Water Conservation

With water becoming less plentiful and more expensive in many parts of the country, interest in water conservation is growing. Easy, no fuss ways to save can be found at the neighborhood hardware and plumbing stores, for they probably are selling a variety of water saving devices for use in home and industry. Some of these ingenious and generally inexpensive gadgets are described below.

Shower flow controls resembling plastic thimbles can be easily inserted in shower heads at a small cost. They reduce the water flow from 8 to about 3 gallons a minute. The control compensates for any changes in home water pressure and keeps the flow constant so that the shower is scarcely affected.

Flow control inserts for spigots also are available. They can cut the water flow to 1.5 gallons a minute for lavatories and 1.5 to 4.0 gallons a minute for sinks.

Special toilet valve assemblies are being manufactured which will detect and prevent leaking. A relatively inexpensive replacement for the ballcock assembly, this device is designed to quickly shut off the water closet valve when the tank is filled or there is a leak or malfunction. Some will make a noticeable noise when the tank ball is defective. This appliance should be installed by a registered plumber.

Several reservoir displacement inserts for water closets are out on the market. They are a refinement of the old brick-in-the-tank method but, unlike a dropped brick, they do not damage the expensive porcelain container when installed. These water displacement devices save about 2 gallons a flush.

The toilet flush adapter is completely different from the reservoir displacement gadgets. Using a sinker weight and styrofoam float ball, this appliance will convert most toilets to a light-full flush system. Tripping the handle in the normal way results in a partial release of water, while holding the handle down completely empties the reservoir.

A pressure reducing valve is useful in areas where pressures at the tap exceed 80 pounds per square inch. Placed on the house side of the property's water line, it adjusts the incoming pressure to a constant level, generally set in the range of 50 to 60 pounds per square inch. The valve must be installed by a registered plumber.

Those who need to replace bathroom appliances can find new models with conservation devices already built in.

Care can be taken in selecting automatic washing machines and dishwashers for they cannot be easily modified. Check on the number of gallons required by different models during each cycle; they vary widely. Using a washing machine with an adjustable water level control will reduce the volume of water needed for laundering.

A shopping trip for water saving devices or new appliances, perhaps no farther away than just around the corner, can bring knowledgeable consumers substantial savings in both water and money. ■

New Publications

Handbook of Water Data Collection Methods Being Prepared

A new handbook detailing methods of collecting and reporting data pertaining to the quantity and quality of the Nation's water resources is now in preparation by the Coordinating Council for Water-Data Acquisition Methods. The council consists of representatives from 18 Federal agencies and was organized by the Federal Interagency Advisory Committee on Water Data.

A total of 150 engineers and scientists from 25 different Federal agencies have been organized by the council into 10 technical working groups, each assigned to develop a specific chapter in the future handbook.

The chapters will present recommended methods for gathering data on items such as waterborne chemicals, sediment and bacteria, surface water, ground water, precipitation, evaporation, snow and ice, and soil moisture.

Target date for completion of the loose-leaf national handbook is July 1977, with regular updatings planned to incorporate new methods as they are developed.

The new handbook will be an expanded version of the previously published "Recommended Methods for Water-Data Acquisition," now in its third printing. A limited supply of this preliminary edition is available from the Office of Water Data Coordination, U.S. Geological Survey, National Center, MS-417, Reston, Virginia 22092.

Non-Federal involvement has been arranged in two ways: first, through linkages with technical and standard setting societies; second, through the Advisory Committee on Water Data for Public Use (ACWDPU). Those technical societies engaged in developing the type of standards that will be used in preparing the handbook include the American Society for Testing and Materials, American Society of Agricultural Engineers, American Meteorological Association, American Water Works Association and Water Pollution Control Federation.

The second link, a working group of ACWDPU, is a body of nine engineers and scientists representing non-Federal interests. This group is reviewing and evaluating chapter outlines, and also channeling non-Federal review comments into those technical working groups actually preparing the handbook. ■

Hydropower Brochure

As the United States faces a critical energy shortage, it is seeking various potential sources of power. One such source is hydroelectricity, which is particularly suited to providing power to meet peak demands.

The Corps of Engineers is the Nation's largest single producer of hydroelectricity. As of January 1976, the Corps was operating 65 power projects, which produced a total of

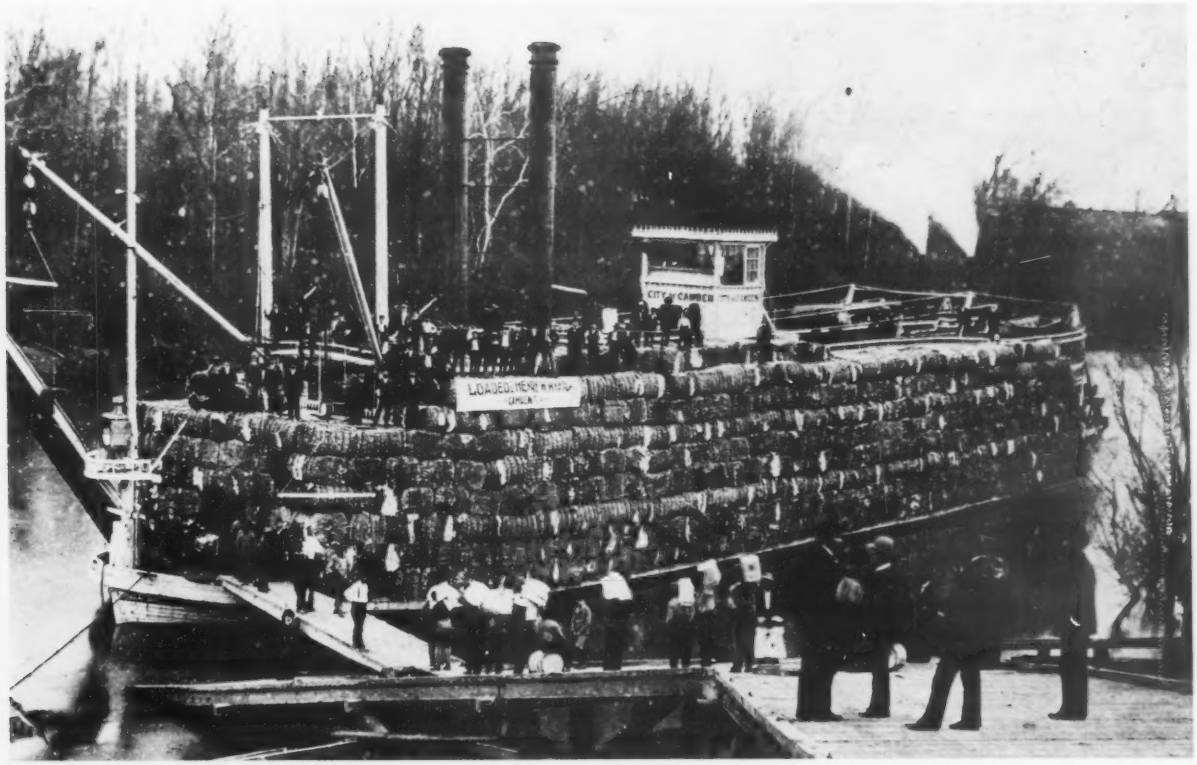


Illustration from the new history shows a pre-Civil War packet boat loading cotton and passengers.

85.3 billion kilowatts of electrical energy in 1975.

A discussion of hydropower, how it works, and where it fits into the total energy picture, as well as the part played by the Corps of Engineers, is presented in a 24-page illustrated booklet called *Hydropower: The Role of the Corps*. Published by the Civil Works Directorate of the Office of the Chief of Engineers, the booklet also discusses peaking and pumped storage. It is available, free of charge, from the Office of the Chief of Engineers, ATTN: DAEN-PA, Washington, D.C. 20314. ■

New Guide to Water Resource Materials

Sources of Information in Water Resources, by Gerald J. Giefer of the University of California, Berkeley, is a bibliography that was recently published by the Water Information Center. As its title implies, the new 290-page volume is designed to save the researcher and student time in locating reference materials about water resource topics.

More than 1,100 sources of information are cited, annotated and arranged into 62 subject subdivisions. Among the subjects are engineering works, water resources planning, nature of water, water cycle and water quality.

Those interested in obtaining further information about this how-to-find-it water resource book can write to Water Information Center, Dept. 25, 14 Vanderventer Avenue, Port Washington, New York 11050. ■

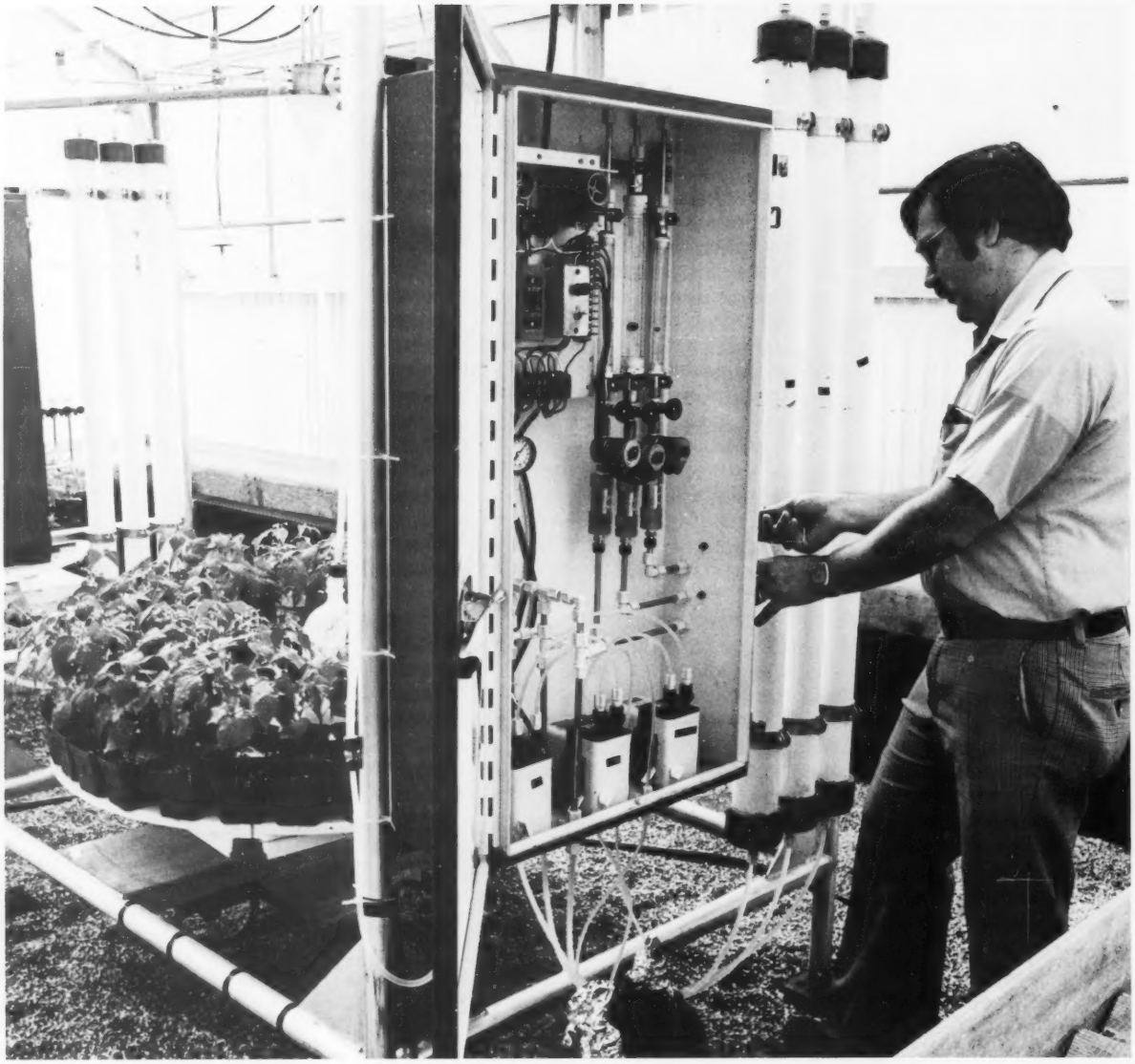
History of Public Works

Water resource development is one of the many contributions that public works has made to the quality of American life. The history of this often neglected aspect of the nation's heritage is surveyed in the American Public Works Association's new *History of Public Works in the United States, 1776-1976*. Produced in observance of the Bicentennial, this illustrated, 750-page volume portrays federally sponsored engineering and technological accomplishments within the context of broad social, economic and political themes. The book has been written by a team of professional historians with the cooperation of many private organizations and public agencies, including the U.S. Army Corps of Engineers. It is intended for the general public as well as public officials, engineers and teachers.

Public works activities relating to water are featured in chapters about waterways, community water supply, flood control and drainage, irrigation, and light and power. The Corps' 200-year record of contributions in these and other public works fields is thoroughly covered.

The history also contains chapters on aspects of land and waterborne transportation, topics relating to city life, a philosophy of public service and a perspective on the public works professions of engineering and administration.

Inquiries about the *History of Public Works in the United States, 1776-1976* can be sent to the American Public Works Association, 1313 East 60th Street, Chicago, Illinois 60637. ■



Rainmaker David Shriner prepares an acid rainfall for kidney bean plants.

The Rainmaker

An experimental device that makes rain to order is being used at Oak Ridge National Laboratory to study the effects of sulfur and other atmospheric pollutants on vegetation and solids.

The fully automatic "rainmaker" was designed by a scientist at the research laboratory which is operated by Union Carbide Corporation's Nuclear Division for the Energy Research and Development Agency. It can be programmed to control the size of rain drops, the intensity with which they fall and their chemical composition. The system has been installed in a controlled environment greenhouse and can operate unattended for 1 week.

The acidity of precipitation is receiving worldwide attention because of the increase in sulfur and nitrogen oxides released to the atmosphere from coal fired power plants and industrial emissions. Washing out in rainfall, these contaminants become incorporated in the hydrologic cycle.

Ordinary rain is somewhat acidic, with a pH of about 5.7. This compares to a neutral value of 7 on the scale used to measure varying degrees of acidity or alkalinity. Any lower pH value in precipitation is caused by some chemical in the atmosphere such as sulfur or nitrogen oxide.

Data collected from the Walker Branch Watershed, a 25-acre experimental site at Oak Ridge, indicate that sulfur levels in rainfall account for 86 percent of the total sulfur input to the watershed. The acidity of individual rainstorms monitored at Walker Branch has been as low as pH 3.25. The yearly average rain acidity measured at the watershed is pH 4.2.

The rainmaking device permits the duplication of rain intensity and droplet size with variations typical of natural

precipitation. It can provide a shower or a storm of any desired duration.

Metering pumps supply controlled concentrations of chemical elements to purified water used to stimulate acid rainfall. An identical system is operated as a control and is programmed to produce unpolluted rainfall.

Preliminary studies indicate that simulated acid rain may significantly affect the physiological processes of plants. The weathering of protective surface waxes on both forest and agricultural plant species was found to be accelerated when they were exposed to acid rain. This could result in increased leaching of nutrients from the leaves of the plants.

The study also shows that simulated acid rain inhibits nodule formation on root systems of leguminous crops and causes some plants to be more susceptible to disease.

Future studies will focus on consequences of prolonged exposure of natural ecosystems to acid rain and will guide decisions on whether new environmental standards are needed. ■

Experiment Pays Off

The experimental hiring of live-in attendants at a Corps of Engineers campground 2 years ago has won its initiator $1,000 under the President's cost reduction program and recently was recommended as a nationwide practice by the Chief of Engineers.

Following the experiment's initial success at Table Rock Lake, Missouri, where it was begun by resident engineer Richard Groves, the program was tried at 10 Corps operated parks and saved the Little Rock District almost $60,000 in its first year of operation. Since the Corps operates more than 2,000 parks in 38 districts, use of the program on a nationwide basis could result in substantial savings.

Reasons for its financial success are that the attendants, usually retired couples, collect fees and assist campers which reduces the number of extra rangers needed. They also provide clean-up service for the parks, eliminating the necessity for separate clean-up contracts.

An extra benefit of having attendants living in parks is that their 24-hour presence deters vandals and helps keep peace among the campers.

The program will not be made mandatory by the Corps because the remote location or multiple-entrance design of some campgrounds might make it impractical. ■

A Patch Of Past Left For Future

by Jenny Pulliam
Kentucky Department for Natural Resources and Environmental Protection

Most people can't leave a whole lot to posterity. And, those who do, usually don't leave an atmosphere—a bit of land untouched by time and encroaching progress—a small stand of virgin timber such as that in the Lilley Cornett Woods in Kentucky.

But Lilley Cornett could and did. In 1918—not long after World War I—he bought the Letcher County woods that now bear his name. Despite the offers of many people to buy the timber, he continually refused to let any trees on the land be cut. A few chestnut trees killed by the chestnut blight are the only ones he ever allowed to be cut. He even bought lumber for the farm from his neighbors.

When Cornett died, he left more than a 554-acre forest to his children. To a state that was once blanketed by natural forests, he left one of its last virgin timber stands—175 acres of virgin forest.

His children, who also wouldn't allow the timber to be cut, wanted some agency to buy the land and preserve it for future generations. In 1969, the state of Kentucky bought it and, in that way, it came to be in the hands of the division of forestry in the Kentucky Department for Natural Resources and Environmental Protection.

According to forestry director Harry Nadler, research reports indicate that the Lilley Cornett Woods is one of the last and largest evidences of an era that goes back 70 million years. That's the era of one of the greatest forests of all time—the Mixed Mesophytic Forest. Besides the forests of the tropics, that forest held more species of trees than any other in the world. And, Nadler said, the Mixed Mesophytic Forest may have reached its richest and finest development in the Cumberland Mountains of eastern Kentucky.

The Mixed Mesophytic Forest was bound to that eastern Kentucky region due to geologic and climatic changes that began 30 million years ago, said Nadler. Some mountain areas in China could still contain a forest like the Lilley Cornett Woods and a few small tracts elsewhere may contain some evidence of that time.

Nadler said that many of the 64 species of trees that have been found in the Lilley Cornett Woods were growing at the time Columbus discovered America. The virgin timber that remains includes a red oak 51.2 inches in diameter, a chestnut oak 47.4 inches in diameter and a white oak 47.2 inches in diameter and 150 feet tall.

Plants found in the Lilley Cornett Woods—but rarely found elsewhere—include crested dwarf iris, pink lady's slipper, spotted mandarin, belleart and trillium.

For visitors to the Lilley Cornett Woods, an information building and museum are open near the forest. Anyone needing information on the woods should contact the Director of Division of Forestry, Kentucky Department for Natural Resources and Environmental Protection, 618 Teton Trail, Frankfort, Kentucky 40601. ■

World's Largest Dam

Brazil and Paraguay are jointly building the largest dam in the world across the Parana River near the Iguazu Falls and the Brazil-Argentina border. The concrete center of Itaipu Dam will be as tall as a 59-story building. The Itaipu will generate six times more electricity than Aswan and a quarter again as much as Grand Coulee. Its cost is currently estimated at $5.8 billion. ■

Digest Discusses Wetlands and Corps

"Victory in the Wetlands" is an article in the September 1976 *Reader's Digest* which may be of interest to *Water Spectrum* readers. It relates the value of our coastal wetlands, which serve in such life-supporting activities as food supply,

waste treatment and fish nurseries. Within the scope of the article there is a discussion of the Corps' role not only in protecting existing wetlands but in helping to accomplish "what no one in this country had ever done: create a tidal marsh." ■

Birds of a Feather?

The National Audubon Society and the U.S. Army Corps of Engineers may sometimes hold opposing views, but their local units at Rend Lake, near Benton, Illinois, seem to be working together in a most compatible fashion. The Society's area chapter recently cited the Corps' Rend Lake management office for outstanding service in establishing wildlife sanctuaries and promoting outdoor education and wildlife research. In the special award ceremony, the local office also was commended for its cooperation with conservation, environmental and educational groups. ■

New Ice Research Lab

Construction of an ice research facility adjacent to the Corps of Engineers Cold Regions Research and Engineering Laboratory (CRREL) is underway at Hanover, New Hampshire. The 70,000-square-foot lab will be used by CRREL engineers and scientists to investigate ice phenomena related to rivers, lakes, harbors and other navigable waters. For these purposes, the facility will contain three refrigerated zones: a test basin, a flume room and a research area as well as workroom, office and instrumentation space. It is scheduled for completion in the winter of 1977-78.

Studies to be conducted there will cover such areas as evaluation of ice forces in structures, formation of ice pressure ridges, ice problems in and around navigation locks and the hydraulics of ice covered rivers.

The research carried out at the new laboratory is expected to lead to the development of improved designs for locks, dam spillways, powerhouses and ice control structures. ■

Coming Events

Water Resources Congress Annual Meeting and Marine Exposition at St. Louis, Mo., February 5-7.

31st Annual National Association of Conservation Districts at Atlanta, Ga., February 6-10.

The American Society of Photogrammetry and The American Congress on Surveying and Mapping Convention at Washington, D.C., February 27-March 5.

National Wildlife Federation Annual Meeting at Washington, D.C., March 5-9.

42nd North American Wildlife and Natural Resources Conference at Atlanta, Ga., March 7-9.

5th Conference on the Prevention, Behavior, Control and Clean-up of Oil Pollution at New Orleans, La., March 8-10.

International Congress of Game Biologists at Atlanta, Ga., March 11-15.

Soil Conservation Society of America National Symposium at Omaha, Neb., March 21-24.

19th Annual Public Water Supply Engineers Conference at Champaign, Ill., April 5-7.

Ducks Unlimited National Convention at San Francisco, Calif., April 19-23.

1977 National Conference on Treatment and Disposal of Industrial Wastewaters and Residues at Houston, Tex., April 26-28.

Game Conservation International Conference at San Antonio, Tex., May 8-13.

1977 National Conference On Water at St. Louis, Mo., May 23-25.

Outdoor Writers National Conference at Macon, Ga., June 18-24.

Society For International Development Growth Conference at Houston, Tex., October 2-4. ■

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This meadowlark at Flint Hills Refuge in Kansas is among the many songbirds that also benefit from existence of State-leased wildlife management areas at Corps water resource projects. See page 1.

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